Insect survey 2020, basic analysis

Jens Å

20 November, 2020

Contents

To-do * Remove extra lysation samples!!! Some samples got two runs, with two lysate runs

- These species are not matched to the gyldig names in artsdatabasen yet.
- Should store dates and times separately as well in logger_data table. Easier to subset later.

- Notera i rapport hur många treffer som er misstenkte.
- Make plots of phenology
  - No. species over the season for each location. Split into separate figs for the two habitats?
  - Relate this to local temperature, temperature sums?
- Plots of number of samples over time
- Check differences btw 2 week and 4 week sampling
  - Compare first and second of the 2 weeks, see if any of the have more overlap with 4 week. If 4 week becomes full, the first 2 week period should overlap more.
  - Do this for window traps as well.
- Within habitat, check relationship btw species richness and a few variables
  - Forest age
  - Diversity of fauna
  - Temperature
  - Altitude

Data import and cleaning

At this point I get the raw data from Marie, which requires some cleaning. In the future, we'll put this all in a database, and separate out the cleaning and database import in a separate script.

```
#dat <- read.delim("../../Data/Genetikkdata/long_format_data_GCF-2020-735_736_19102020.txt"
#  as.tibble()

#dat <- read_delim("../../Data/Genetikkdata/long_format_data_GCF-2020-735_736_19102020.txt"

dat <- read_delim("../../Data/Genetikkdata/long_format_data_GCF-2020-735_736_744_26102020.tx
                  delim= ";",
                  col_types = cols(
  kingdom = col_character(),
  phylum = col_character(),
  class = col_character(),
  order = col_character(),
  family = col_character(),
  genus = col_character(),
  species = col_character(),
  sample = col_character(),
  value = col_double(),
  GenlabID = col_character(),
```

```
  GUID = col_character(),
  Tilsatt_antall_C.analis_SI_USA_08.06.20 = col_double(),
  Tilsatt_antall_C.chinensis_08.06.20 = col_double(),
  Tilsatt_antall_Sirisser = col_double(),
  Tilsatt_antall_Melormer = col_double(),
  Tilsatt_antall_C.maculatus = col_double(),
  Vekt_tom_flaske_.g. = col_double(),
  Vekt_flaske_med_EtOH_og_insekter_.g. = col_double(),
  Vekt_flaske_._insekter_vaat_.g. = col_double(),
  Vekt_flaske_._insekter_toerr_.g. = col_double(),
  Totalvolum_.mengde_ATL_._prot.K_mL. = col_character(),
  Vaatvekt_.g. = col_double(),
  Toerrvekt_.g. = col_double(),
  Kommentar_proeve = col_character(),
  Ekstraksjonsdato = col_date(format = "%d.%m.%Y"),
  Ekstraksjonskit = col_character(),
  Subsamplet_volum_.ul. = col_double(),
  Elueringsvolum = col_double(),
  OD = col_double(),
  X260_280 = col_double(),
  X260_230 = col_double(),
  Labperson = col_character(),
  Ekstraksjonskommentar = col_character(),
  locality = col_character(),
  trap = col_character(),
  date_placed = col_date(format = "%d.%m.%Y"),
  time_placed = col_time(format = ""),
  empty_week = col_double(),
  date_emptied = col_date(format = "%d.%m.%Y"),
  time_emptied = col_time(format = ""),
  liquid = col_character(),
  person_emptied = col_character(),
  sample_id = col_character(),
  mottat_lab = col_character(),
  comment = col_character()
),
na = c("NA",
       "N/A",
       "Maa veies"
)
)
```

Fix some coding errors.

```
# dat %>%
#   select(genus, species, new_species) %>%
```

```
# slice(297, 1902)
#
#
# dat %>%
#   select(genus, species, new_species) %>%
# slice(3219, 3585, 4017, 11424, 13275, 15465, 21056, 24168, 25077, 31567, 32805, 48502, 49
#
#Ekstraksjonskommentar = gsub(pattern = "[\\\"]", "", Ekstraksjonskommentar),

dat <- dat %>%
  mutate(species_latin = species)

dat <- dat %>%
  mutate(species = gsub(" sp", "_sp", species))

dat <- dat %>%
  mutate(species = gsub("([0-9])(_)(sp)", "\\1/\\3", species))

dat <- dat %>%
  mutate(species = gsub("(.*)(_)(.*)", "\\3", species))

dat <- dat %>%
  mutate(locality = str_to_sentence(locality))
```

Set factor levels

```
dat <- dat %>%
  mutate(locality = factor(locality, levels = c(paste0("Semi-nat_", 1:10), paste0("Skog_", 1
         trap_type = ifelse(grepl("MF", trap), "Malaise", "Vindu"),
         habitat_type = ifelse(grepl("Skog", locality), "Skog", "SN_Gressmark"),
         liquid = ifelse(grepl("etoh85", liquid), "Ethanol", "PropGl_Ethanol"),
         weeks_sampled = ifelse(grepl("1", trap) | grepl("3", trap), 2, 4)
         )
```

Write a species list for the entomologists

```
dat %>%
  select(kingdom,
         phylum,
         class,
         order,
         family,
         genus,
         species) %>%
```

```
  distinct() %>%
  arrange(kingdom,
          phylum,
          class,
          order,
          family,
          genus,
          species) %>%
  write_excel_csv(path = "out/species_list_2020-11-02.csv")
```

```
## Warning: The `path` argument of `write_excel_csv()` is deprecated as of readr 1.4.0.
## Please use the `file` argument instead.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_warnings()` to see where this warning was generated.
```

Filter out the Nerlandsøya samples

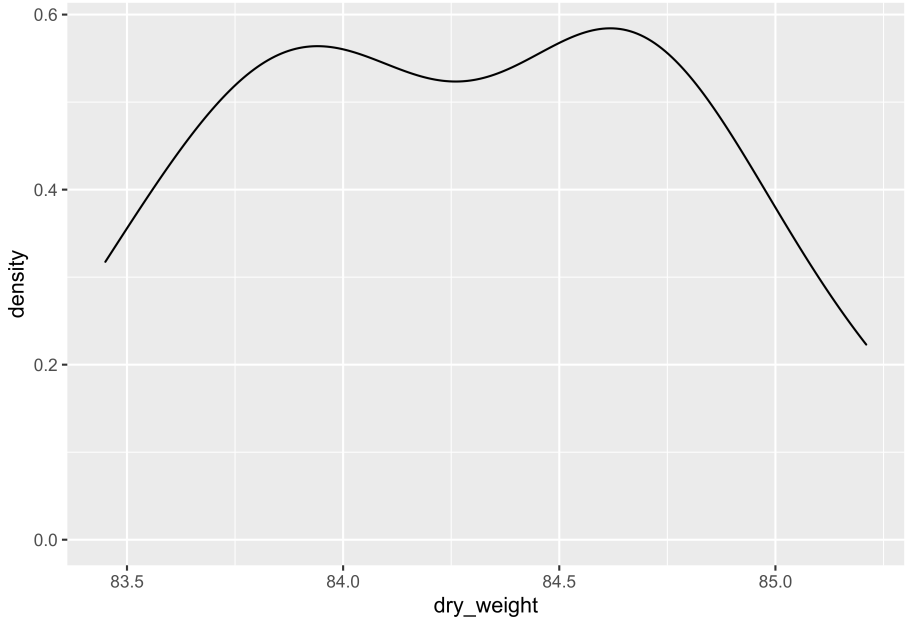
```
dat <- dat %>%
  filter(locality != "Nerlandsoeya") %>%
  droplevels()
```

Add missing bottle weights. This is based on a sample of bottle dry weight measurements made after the regular weighings.

```
bottle_weights <- tbl(con,
                      in_schema("catch_data", "bottle_weights")) %>%
  select(-id)
```

```
## Warning in postgresqlExecStatement(conn, statement, ...): RS-DBI driver warning:
## (unrecognized PostgreSQL field type uuid (id:2950) in column 0)
```

```
bottle_weights %>%
  filter(bottle_type == "MF" & year == 2000) %>%
  select(dry_weight) %>%
  ggplot(.) +
  geom_density(aes(x = dry_weight))
```




```
bottle_weights_MF <- bottle_weights %>%
  filter(bottle_type == "MF" & year == 2000) %>%
  select(dry_weight) %>%
  summarize(mean_weight = mean(dry_weight)) %>%
  collect()
```

```
## Warning: Missing values are always removed in SQL.
## Use `mean(x, na.rm = TRUE)` to silence this warning
## This warning is displayed only once per session.
```

```
sum(is.na(dat$Vekt_tom_flaske_.g.))
```

```
## [1] 6572
```

```
dat <- dat %>%
  mutate(Vekt_tom_flaske_.g. = ifelse(trap_type == "Malaise" & is.na(Vekt_tom_flaske_.g.), b

sum(is.na(dat$Vekt_tom_flaske_.g.))
```

```
## [1] 1368
```

```
dat <- dat %>%
  mutate(Vaatvekt_.g. = Vekt_flaske_._insekter_vaat_.g. - Vekt_tom_flaske_.g.,
         Toerrvekt_.g. = Vekt_flaske_._insekter_toerr_.g. - Vekt_tom_flaske_.g.)
```

Check the emptying dates.

The dates seems to be OK this time. Should do a proper check on the endpoints though.

```
dat <- dat %>%
  mutate(days_collected = as.numeric(dat$date_emptied - dat$date_placed))

# dat %>%
#   filter(days_collected == 0) %>%
#   select(sample_id,
#          GUID,
#          date_placed,
#          date_emptied) %>%
#   distinct() %>%
#   print(n = Inf)
#
# hist(as.numeric(dat$date_emptied - dat$date_placed))
```

```
dat %>%
  group_by(days_collected) %>%
  summarise(n())
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

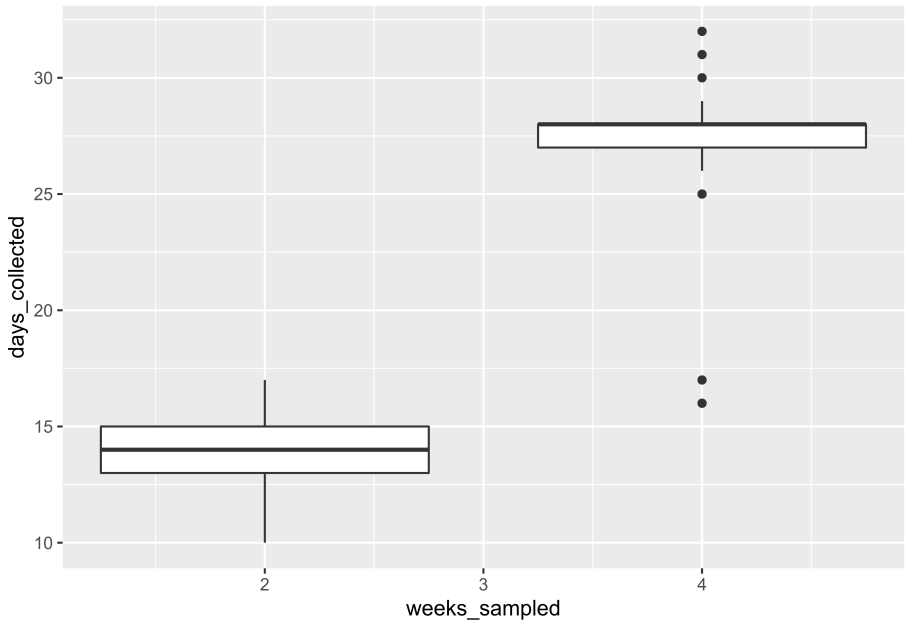
```
## # A tibble: 16 x 2
##    days_collected `n()`
##             <dbl> <int>
##  1             10   368
##  2             11  1084
##  3             12  5654
##  4             13  6223
##  5             14 10831
##  6             15  8053
##  7             16 11159
##  8             17  1422
##  9             25   561
## 10             26  1101
## 11             27  3016
## 12             28  9687
## 13             29  1132
## 14             30   450
## 15             31  1175
## 16             32   734
```

```
# dat %>%
#   filter(days_collected == 8) %>%
```

```
#   select(sample_id,
#          GUID,
#          date_placed,
#          date_emptied) %>%
#   distinct() %>%
#   print(n = Inf)
```

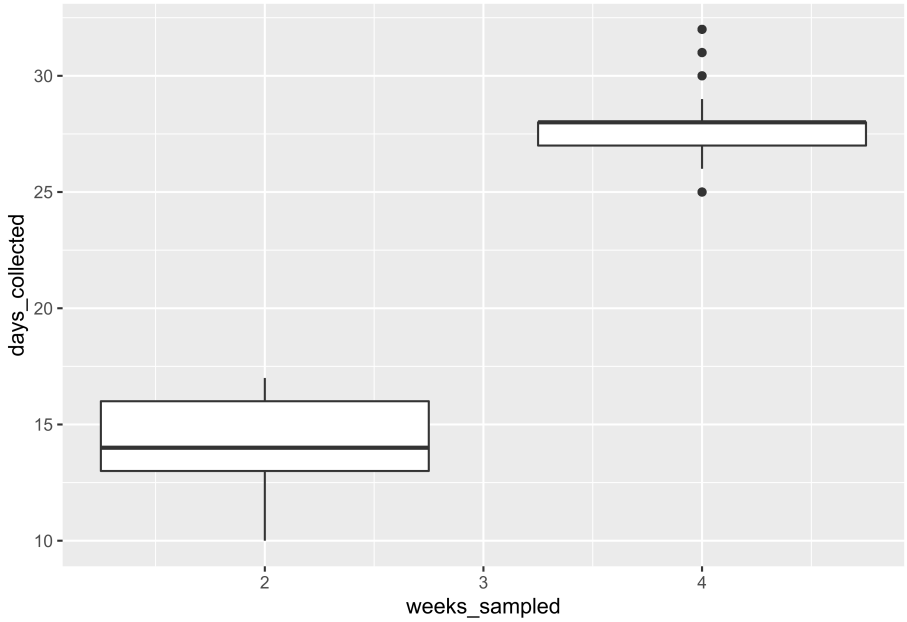
Set weeks sampled manually for the few locations in Oslo that got an extra short sampling in the beginning.

```
ggplot(dat, aes(x = weeks_sampled, y = days_collected, group = weeks_sampled)) +
  geom_boxplot()
```




```
twoWeeks <- dat %>%
  filter(weeks_sampled == 4 &
           days_collected < 20) %>%
  select(sample_id) %>%
  distinct() %>%
  as.vector()


dat <- dat %>%
  mutate(weeks_sampled = ifelse(sample_id %in% twoWeeks[[1]], 2, weeks_sampled))
```

```
ggplot(dat, aes(x = weeks_sampled, y = days_collected, group = weeks_sampled)) +
  geom_boxplot()
```



Check missing weight data

```
dat %>%
  group_by(empty_week) %>%
  select(Vekt_tom_flaske_.g.,
         Vekt_flaske_med_EtOH_og_insekter_.g.,
         Vekt_flaske_._insekter_vaat_.g.,
         Vekt_flaske_._insekter_toerr_.g.,
         Vaatvekt_.g.,
         Toerrvekt_.g.
         ) %>%
  distinct() %>%
  summarise_all(~sum(is.na(.)))
```

```
## Adding missing grouping variables: `empty_week`
```

```
## # A tibble: 6 x 7
##   empty_week Vekt_tom_flaske~ Vekt_flaske_med~ Vekt_flaske_._i~ Vekt_flaske_._i~
##        <dbl>            <int>            <int>            <int>            <int>
## 1         22                6                0                0                0
## 2         24               20                0                0                0
## 3         26               10                3                0                2
```

```
## 4         28                4                 9                 0                 0
## 5         30                2                 2                 0                 2
## 6         32                0                 0                 0                 0
## # ... with 2 more variables: Vaatvekt_.g. <int>, Toerrvekt_.g. <int>
```

Summaries of samples

Total weight of insect catches.

```
dat %>%
  group_by(sample_id) %>%
  summarise(dry_weight = mean(Toerrvekt_.g., na.rm = T),
            wet_weight = mean(Vaatvekt_.g., na.rm = T)) %>%
  summarise(tot_dry_weight = sum(dry_weight, na.rm = T),
            tot_wet_weight = sum(wet_weight, na.rm = T))
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

```
## # A tibble: 1 x 2
##   tot_dry_weight tot_wet_weight
##            <dbl>          <dbl>
## 1          1460.          6249.
```

Total number of taxa

```
dat %>%
  summarise(no_taksa = n_distinct(order, family, genus, species))
```

```
## # A tibble: 1 x 1
##   no_taksa
##      <int>
## 1    10092
```

Basic species richness graphs

Quick look at diversity at the different sites.

```
total_no_taxa <- dat %>% select(order, family,genus,species) %>%
  distinct() %>%
  count()
```

```
dat %>%
  filter(grepl("MF", trap)) %>%
  group_by(locality, habitat_type) %>%
  select(genus, species, habitat_type) %>%
  distinct() %>%
```

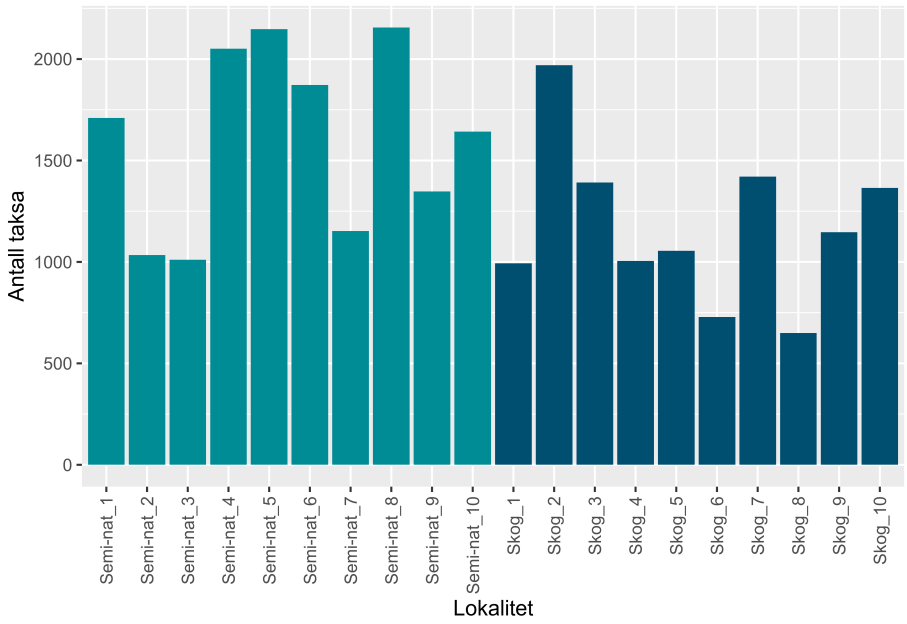


Figure 1: Cumulative number of taxa found in malaise traps.

```
  count() %>%
  ungroup() %>%
  ggplot(.) +
 geom_bar(aes(y = n, x = locality, fill = habitat_type),
           stat = "identity") +
 # ggtitle(paste0("Kumulativ artsrikedom i\nalle malaisefeller per ", max(dat$date_emptied),
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1),
        legend.position = "none") +
    scale_fill_nina() +
  ylab("Antall taksa") +
  xlab("Lokalitet")
```

```
## Adding missing grouping variables: `locality`
```

```
dat %>%
  filter(grepl("VF", trap)) %>%
  group_by(locality, habitat_type) %>%
  select(genus,species) %>%
  distinct() %>%
  count() %>%
  ungroup() %>%
  ggplot(.) +
```

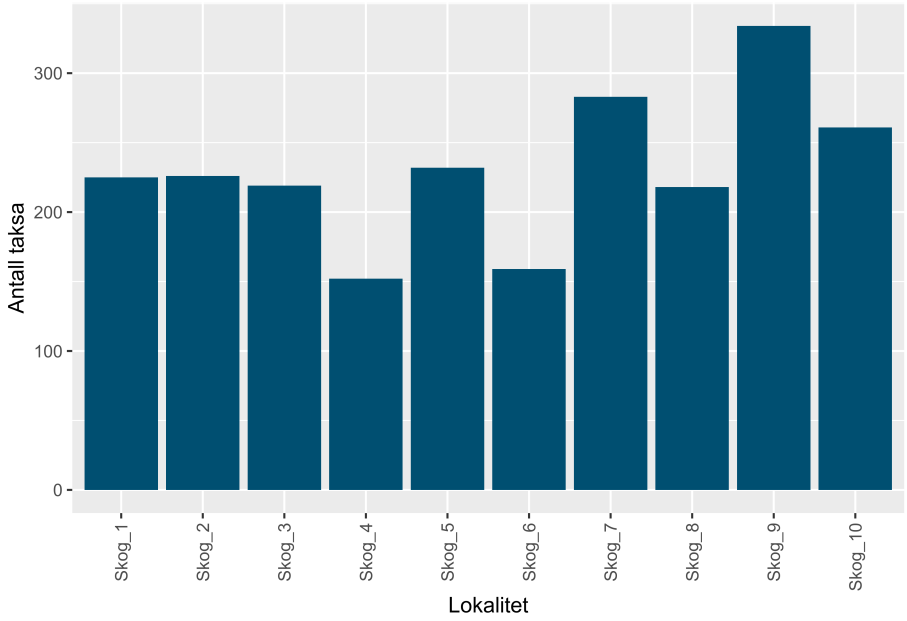


Figure 2: Cumulative number of taxa found in window traps.

```
  geom_bar(aes(y = n, x = locality, fill = habitat_type),
           stat = "identity") +
#  ggtitle(paste0("Kumulativ artsrikedom i\nalle vindusfeller per  ", max(dat$date_emptied,
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1),
        legend.position = "none")  +
    scale_fill_nina() +
  ylab("Antall taksa") +
  xlab("Lokalitet")
```

```
## Adding missing grouping variables: `locality`, `habitat_type`
```

Basic biomass graphs

NB, we still have some missing data on the weight of the bottles.

Quick quality check of the spread of the bottle weights. Could we impute the missing values?

```
dat %>%
  select(Vekt_tom_flaske_.g.,
         Vekt_flaske_med_EtOH_og_insekter_.g.,
```

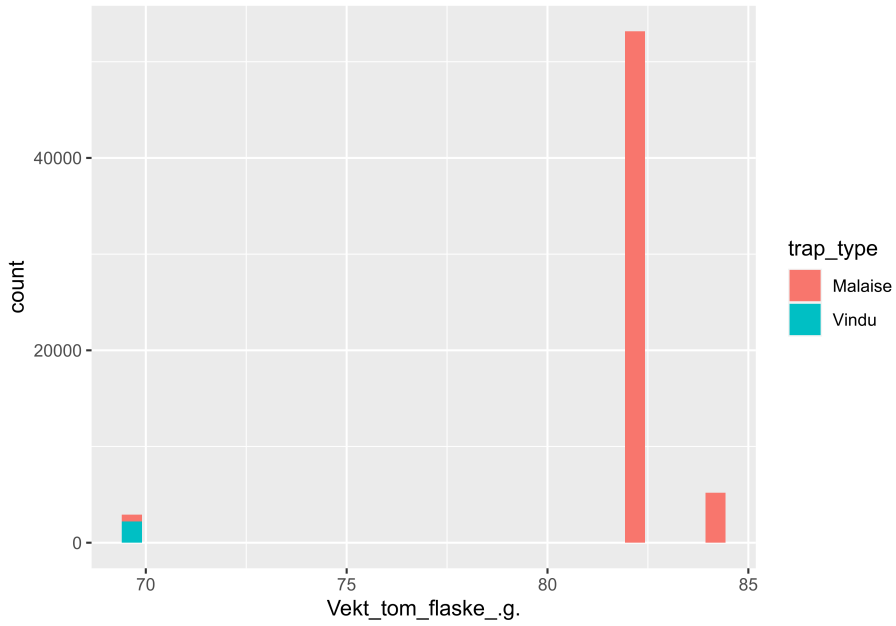
```
        Vekt_flaske_._insekter_vaat_.g.,
        Vekt_flaske_._insekter_toerr_.g.,
        Vaatvekt_.g.,
        Toerrvekt_.g.)
```

```
## # A tibble: 62,650 x 6
##    Vekt_tom_flaske~ Vekt_flaske_med~ Vekt_flaske_._i~ Vekt_flaske_._i~
##               <dbl>            <dbl>            <dbl>            <dbl>
##  1             82.2              728             118.             89.0
##  2             82.2              728             118.             89.0
##  3             82.2              728             118.             89.0
##  4             82.2              728             118.             89.0
##  5             82.2              728             118.             89.0
##  6             82.2              728             118.             89.0
##  7             82.2              728             118.             89.0
##  8             82.2              728             118.             89.0
##  9             82.2              728             118.             89.0
## 10             82.2              728             118.             89.0
## # ... with 62,640 more rows, and 2 more variables: Vaatvekt_.g. <dbl>,
## #   Toerrvekt_.g. <dbl>
```

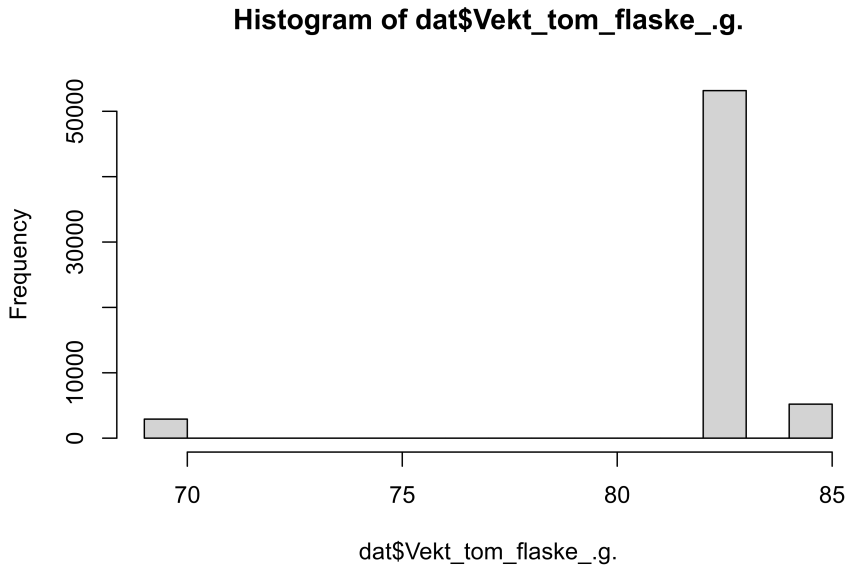
```
ggplot(dat)  +
  geom_histogram(aes(Vekt_tom_flaske_.g., fill = trap_type))
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

```
## Warning: Removed 1368 rows containing non-finite values (stat_bin).
```




```
hist(dat$Vekt_tom_flaske_.g.)
```




```
table(dat$Vekt_tom_flaske_.g.)
```

```
##
```

```
##             69.75             82.21           82.2103 84.2816666666667
##              2915             40333             12830              5204
```

These bottle weights are weirdly consistent. Did they really weigh all bottles?
UPDATE WITH NEW BOTTLE WEIGHTS. !!DONE!!

```
summary(dat$Toerrvekt_.g.)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   -0.57    4.84    8.33   13.61   16.17   80.35    4207
```

Quick look at the biomass at the different sites.

```
dat %>%
  filter(grepl("MF", trap)) %>%
  group_by(locality, habitat_type) %>%
  ggplot(.) +
 geom_boxplot(aes(y = Toerrvekt_.g., x = locality, fill = habitat_type)) +
 # ggtitle(paste0("Middels avrunnen vekt (pluss flaske)\nav insekter i malaisefeller per ",
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1),
        legend.position = "none") +
    scale_fill_nina() +
  ylab("Vekt (g.)") +
  xlab("Lokalitet")
```

```
## Warning: Removed 2839 rows containing non-finite values (stat_boxplot).
```

```
dat %>%
  filter(grepl("VF", trap)) %>%
  group_by(locality, habitat_type) %>%
  ggplot(.) +
 geom_boxplot(aes(y = Toerrvekt_.g., x = locality, fill = habitat_type)) +
  #ggtitle(paste0("Middels avrunnen vekt (pluss flaske) av insekter i\nvindusfeller per ", m
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1),
        legend.position = "none") +
    scale_fill_nina() +
  ylab("Vekt (g.)") +
  xlab("Lokalitet")
```

```
## Warning: Removed 1368 rows containing non-finite values (stat_boxplot).
```

Check overlap between malaise and window traps

Simple: total spec richn for all traps and times per location, plus the same for just malaise and window traps. group in figure by location

complex: tally how many spec is found in only one trap type. No unecessary

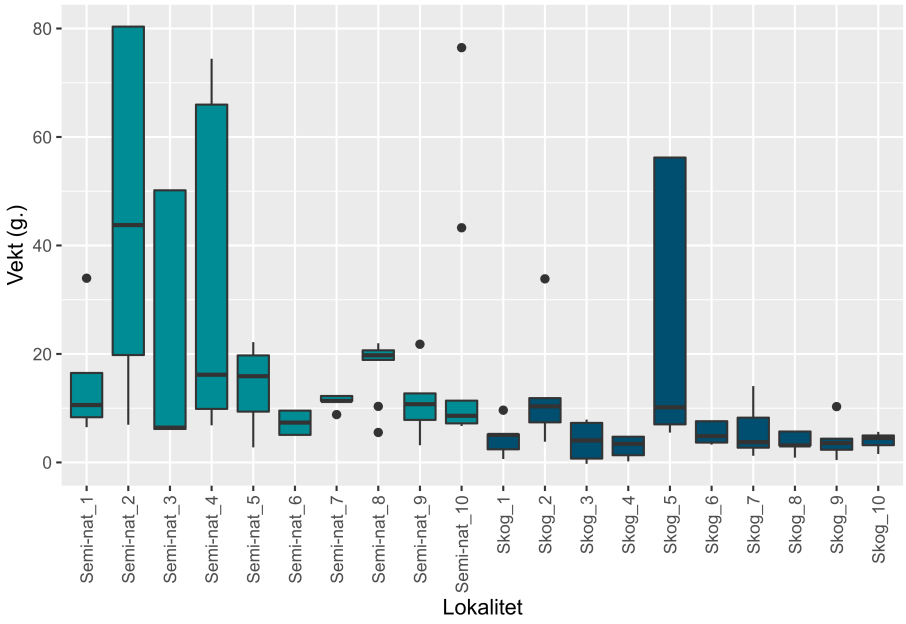


Figure 3: Average biomass (dry weight) in malaiase traps.

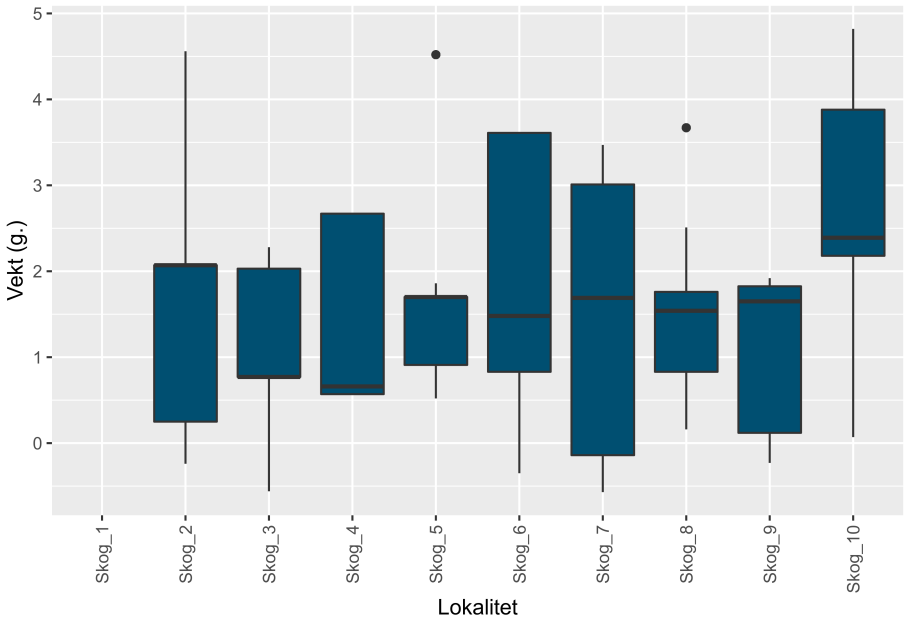


Figure 4: Average biomass (dry weight) in window traps.

per species: which sp is only found in one trap type. or per species, % of findings in each trap type

Total number of coleoptera species per trap type

```
col_spec_richn_tot <- dat %>%
  filter(order == "Coleoptera",
         habitat_type == "Skog") %>%
  group_by(locality) %>%
  summarize(col_spec_richn = n_distinct(genus, species)) %>%
  mutate(trap_type = "Alle")
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

```
col_spec_richn_trap <- dat %>%
  filter(order == "Coleoptera",
         habitat_type == "Skog") %>%
  group_by(locality,
           trap_type) %>%
  summarize(col_spec_richn = n_distinct(genus, species))
```

```
## `summarise()` regrouping output by 'locality' (override with `.groups` argument)
```

```
col_spec_richn <- col_spec_richn_tot %>%
  union_all(col_spec_richn_trap)
```

```
ggplot(col_spec_richn, aes(y = col_spec_richn,
                           x = locality,
                           fill = trap_type)) +
  geom_bar(stat = "identity",
           position = position_dodge()) +
 #   ggtitle(paste0("Kumulativt antall billearter (identifiserte taksa)\ni hver felletyp pe
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1)) +
    scale_fill_nina(name = "Felletype") +
  ylab("Antall taksa") +
  xlab("Lokalitet")
```

Percentage of catches in each trap type per species

How to make it more readable? Split out all the singletons into a separate graph?

```
col_perc_traptype <- dat %>%
  filter(order == "Coleoptera",
         habitat_type == "Skog") %>%
```

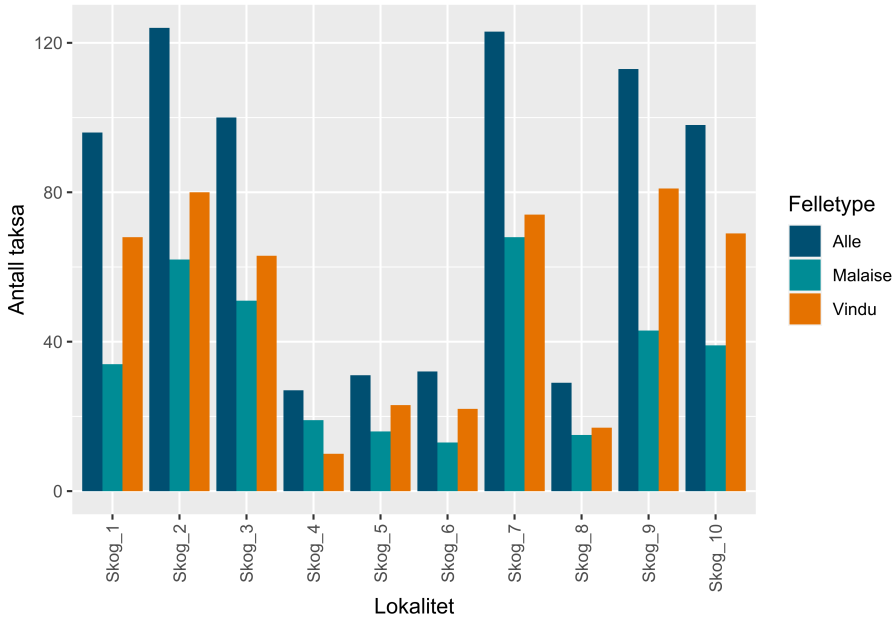


Figure 5: Cumulative number of Coleoptera taxa identified in each trap type

```
  group_by(trap_type,
           genus,
           species_latin) %>%
  summarize(no_catches = n())
```

```
## `summarise()` regrouping output by 'trap_type', 'genus' (override with `.groups` argument
```

```
to_plot_temp <- col_perc_traptype %>%
  ungroup() %>%
  arrange(species_latin,
          trap_type) %>%
  filter(no_catches > 1) %>%
  group_by(species_latin) %>%
  mutate(caught_in = n_distinct(trap_type))

temp_1 <- to_plot_temp %>%
  filter(caught_in == 1) %>%
  arrange(trap_type, species_latin)

temp_2 <- to_plot_temp %>%
  filter(caught_in == 2) %>%
  arrange(species_latin, trap_type)

to_plot <- rbind(temp_1, temp_2) %>%
  ungroup() %>%
  mutate(trap_type = factor(trap_type),
         species_latin = factor(species_latin),
         facet = rep(c(1, 2, 3, 4), times = c(57, 57, 57, 56)))
```

```
to_plot %>%
ggplot(.) +
  geom_bar(aes(y = reorder(species_latin, species_latin), x = no_catches, fill = trap_type),
           stat = "identity",
           position = position_dodge()) +
  scale_fill_nina(name = "Trap type") +
  ylab("") +
  xlab("Number of catches") +
   theme(legend.position = "none",
         text = element_text(size=5)) +
  facet_wrap(facets = vars(facet),
             scales = "free_y",
             strip.position = "right",
             ncol = 4)
```

```
## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA
```

```
## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA
```

```
## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
```

```
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA
```

```
## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA
```

```
## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
```

```
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA
```

```
## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA
```

```
## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
```

```
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA
```

```
## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA
```

```
## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
```

```
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA
```

```
## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA
```

```
## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
```

```
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA
```

```
## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA
```

```
## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
```

```
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA
```

```
## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA
```

```
## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
```

```
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA
```

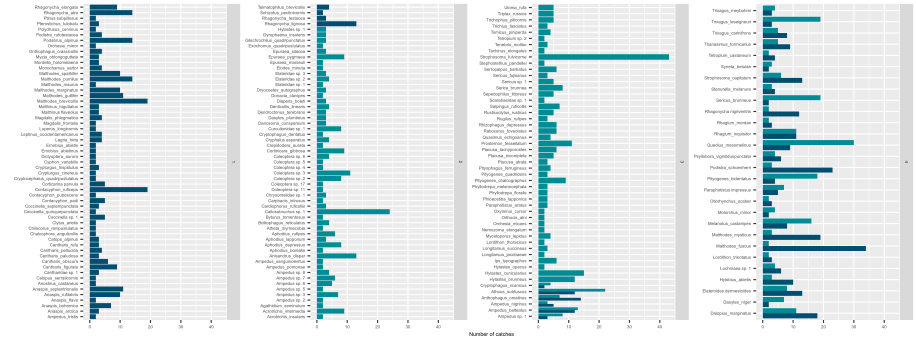
```
## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA
```

```
## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
```

```
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA
```

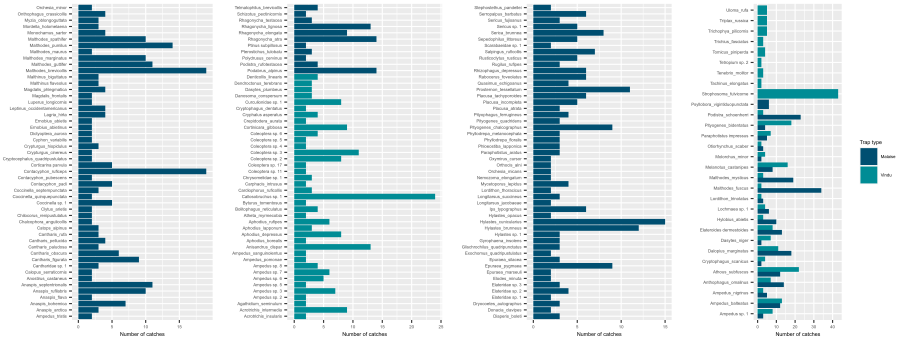
```
## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA
```

```
## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA
```



```
p1 <- to_plot %>%
    slice(1:50) %>%
  group_by(trap_type) %>%
ggplot(.) +
  geom_bar(aes(y = species_latin, x = no_catches, fill = trap_type),
           stat = "identity",
           position = position_dodge()) +
  scale_fill_nina(name = "Trap type") +
  ylab("") +
  xlab("Number of catches") +
   theme(legend.position = "none",
         text = element_text(size=5))


p2 <- to_plot %>%
    slice(51:100) %>%
  group_by(trap_type) %>%
ggplot(.) +
  geom_bar(aes(y = species_latin,  x = no_catches, fill = trap_type),
           stat = "identity",
           position = position_dodge()) +
  scale_fill_nina(name = "Trap type") +
  ylab("") +
  xlab("Number of catches") +
   theme(legend.position = "none",
         text = element_text(size=5))

p3 <- to_plot %>%
```

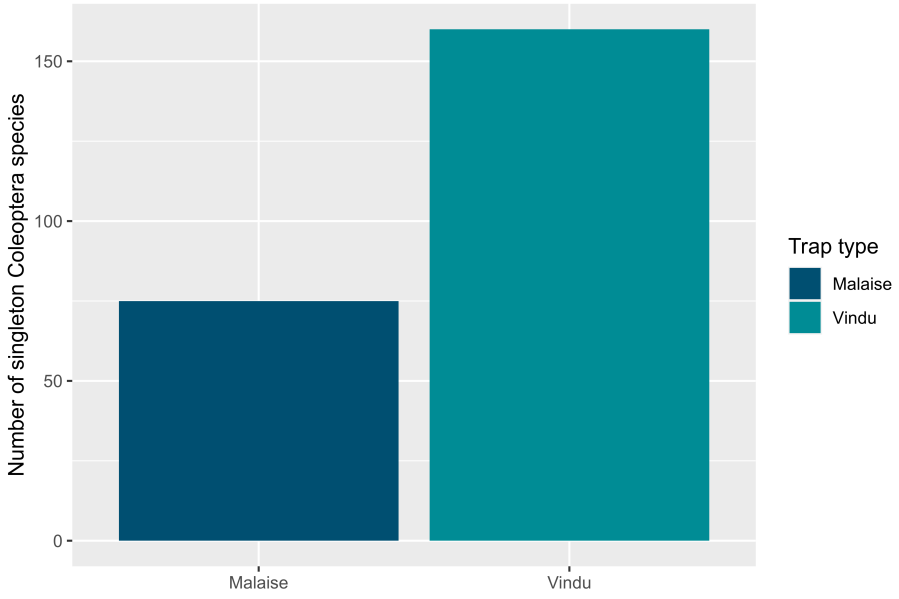
```
    slice(101:150) %>%
  group_by(trap_type) %>%
ggplot(.) +
  geom_bar(aes(y = species_latin, x = no_catches, fill = trap_type),
           stat = "identity",
           position = position_dodge()) +
  scale_fill_nina(name = "Trap type") +
  ylab("") +
  xlab("Number of catches") +
   theme(legend.position = "none",
         text = element_text(size=5))


p4 <- to_plot %>%
    slice(151:200) %>%
  group_by(trap_type) %>%
ggplot(.) +
  geom_bar(aes(y = species_latin, x = no_catches, fill = trap_type),
           stat = "identity",
           position = position_dodge()) +
  scale_fill_nina(name = "Trap type") +
  ylab("") +
  xlab("Number of catches") +
   theme(text = element_text(size=5))

grid.arrange(p1, p2, p3, p4, nrow = 1)
```




```
col_perc_traptype %>%
  ungroup() %>%
  arrange(species_latin,
          trap_type) %>%
  filter(no_catches ==1) %>%
  group_by(trap_type) %>%
  summarize(no_singletons = n()) %>%
```

```
 ggplot(.) +
  geom_bar(aes(y = no_singletons, x = trap_type, fill = trap_type),
           stat = "identity") +
  scale_fill_nina(name = "Trap type") +
  ylab("Number of singleton Coleoptera species") +
  xlab("")
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```



Figs to Niclas on Pollinators

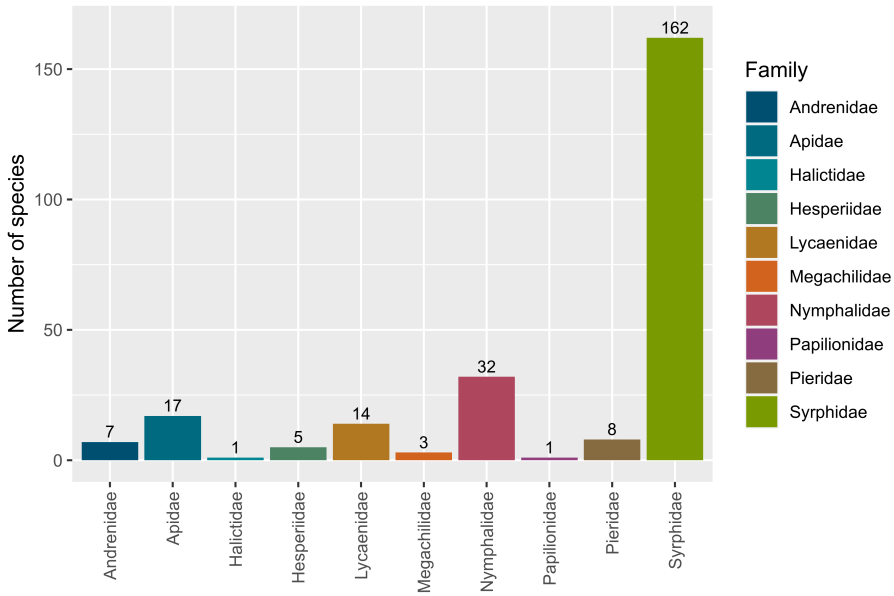
Niclas Gyllenstrand asked how efficient the malaisetraps+metabarcoding are at finding pollinators. This could be a relevant graph for the report as well.

```
poll_spec_richn <- dat %>%
  filter(trap_type == "Malaise") %>%
  filter(family == "Andrenidae" |
         family == "Apidae" |
         family == "Colletidae" |
         family == "Halictidae" |
         family == "Megachilidae" |
         family == "Melittidae" |
         family == "Syrphidae" |
```

```
          family == "Hesperiidae" |
          family == "Lycaenidae" |
          family == "Nymphalidae" |
          family == "Papilionidae" |
          family == "Pieridae" |
          family == "Riodinidae"
            ) %>%
  group_by(family) %>%
  distinct(family, genus, species) %>%
  summarize(col_spec_richn = n(),
            no_unidentified_sp = sum(grepl("sp.", species)))
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

```
ggplot(poll_spec_richn, aes(x = family, y = col_spec_richn, label = col_spec_richn)) +
  geom_bar(stat = "identity",
           aes(fill = family)) +
  geom_text(size = 3,
            position = position_nudge(y = 4)) +
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1)) +
    scale_fill_nina(name = "Family") +
  xlab("") +
  ylab("Number of species")
```



```
pollinator_species <- dat %>%
  filter(trap_type == "Malaise") %>%
  filter(family == "Andrenidae" |
         family == "Apidae" |
         family == "Colletidae" |
         family == "Halictidae" |
         family == "Megachilidae" |
         family == "Melittidae" |
         family == "Syrphidae" |

         family == "Hesperiidae" |
         family == "Lycaenidae" |
         family == "Nymphalidae" |
         family == "Papilionidae" |
         family == "Pieridae" |
         family == "Riodinidae"
           ) %>%
  distinct(order, family, genus, species) %>%
  arrange(family, genus, species)
```

```
dat %>%
  filter(trap_type == "Malaise") %>%
  filter(family == "Apidae") %>%
  distinct(genus, species) %>%
  select(genus, species)
```

```
## # A tibble: 17 x 2
##    genus    species
##    <chr>    <chr>
##  1 Apis     mellifera
##  2 Bombus   soroeensis
##  3 Bombus   pascuorum
##  4 Bombus   lucorum
##  5 Bombus   jonellus
##  6 Bombus   pratorum
##  7 Bombus   monticola
##  8 Melipona illota
##  9 Bombus   consobrinus
## 10 Bombus   cryptarum
## 11 Bombus   sporadicus
## 12 Bombus   cingulatus
## 13 Bombus   hortorum
## 14 Bombus   hypnorum
## 15 Bombus   norvegicus
## 16 Bombus   ashtoni
```

```
## 17 Bombus   terrestris
```

```
write_csv(pollinator_species,
          path = "out/pollinator_species.csv")
```

```
## Warning: The `path` argument of `write_csv()` is deprecated as of readr 1.4.0.
## Please use the `file` argument instead.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_warnings()` to see where this warning was generated.
```

Phenology graphs

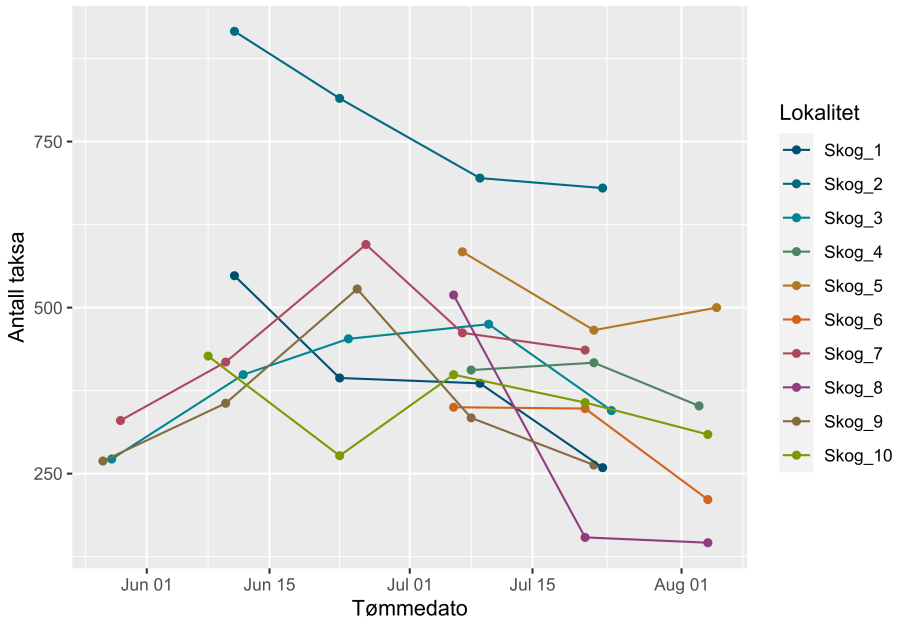
Some "timeseries" throughout the season.

```
seasonAvgNo <- dat %>%
  filter(weeks_sampled == 2) %>%
  group_by(habitat_type, date_emptied, locality) %>%
  summarise(no_species = n_distinct(genus, species),
            sum_biomass = sum(Vekt_flaske_._insekter_vaat_.g., na.rm = T) / no_species)
```

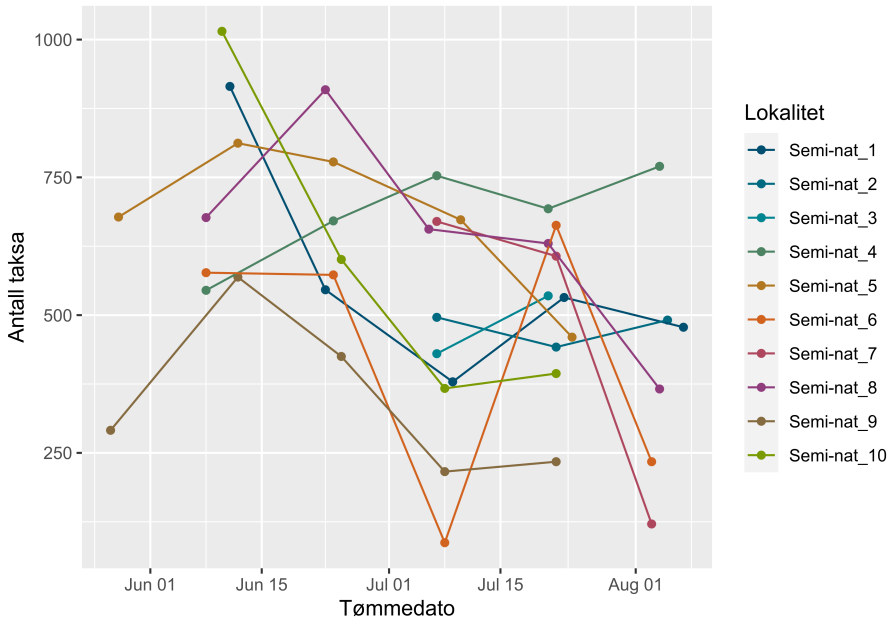
```
## `summarise()` regrouping output by 'habitat_type', 'date_emptied' (override with `.groups
```

```
# test <- seasonAvgNo <- dat %>%
#   filter(weeks_sampled == 2) %>%
#   group_by(habitat_type, date_emptied, locality) %>%
#   select(habitat_type, date_emptied, locality, Vekt_flaske_._insekter_vaat_.g.) %>%
#   distinct() %>%
#   summarise(sum(Vekt_flaske_._insekter_vaat_.g., na.rm = T))
```

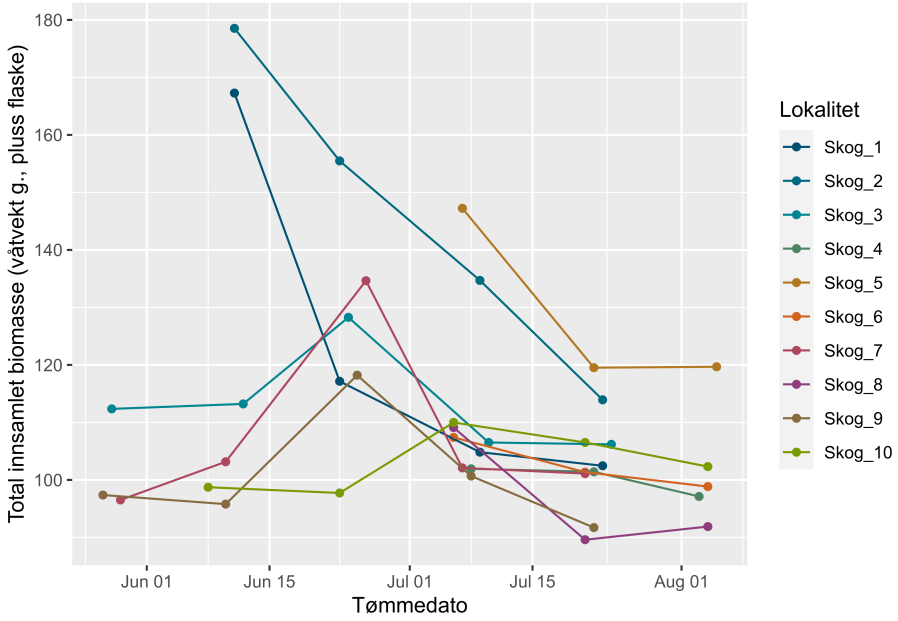
```
seasonAvgNo %>%
  filter(habitat_type == "Skog") %>%
ggplot() +
  geom_point(aes(x = date_emptied, y = no_species, color = locality)) +
  geom_line(aes(x = date_emptied, y = no_species, color = locality)) +
  ylab("Antall taksa") +
  xlab("Tømmedato") +
  scale_color_nina(name = "Lokalitet")
```



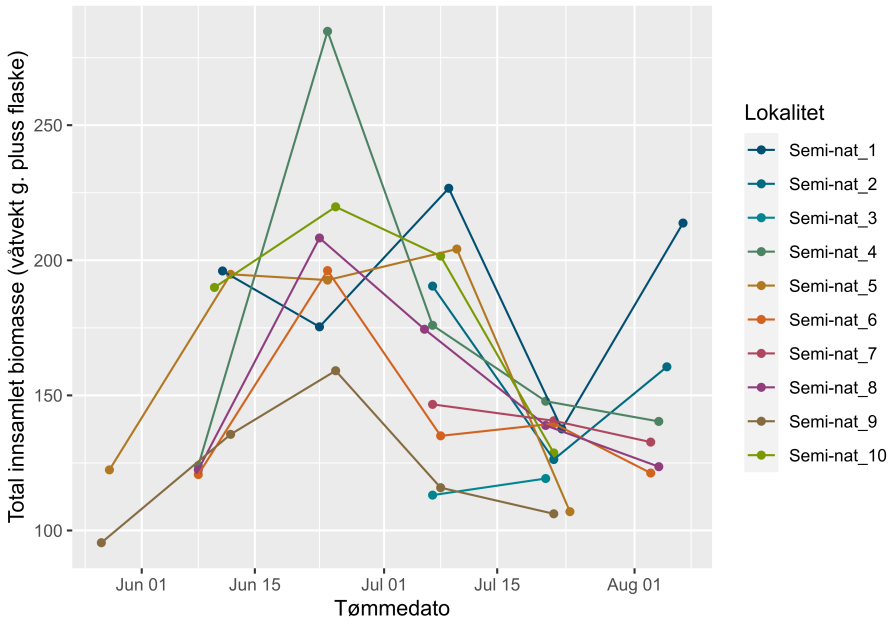

```
seasonAvgNo %>%
  filter(habitat_type == "SN_Gressmark") %>%
ggplot() +
  geom_point(aes(x = date_emptied, y = no_species, color = locality)) +
  geom_line(aes(x = date_emptied, y = no_species, color = locality)) +
  ylab("Antall taksa") +
  xlab("Tømmedato") +
  scale_color_nina(name = "Lokalitet")
```




```
seasonAvgNo %>%
  filter(habitat_type == "Skog") %>%
ggplot() +
  geom_point(aes(x = date_emptied, y = sum_biomass, color = locality)) +
  geom_line(aes(x = date_emptied, y = sum_biomass, color = locality)) +
  ylab("Total innsamlet biomasse (våtvekt g., pluss flaske)") +
  xlab("Tømmedato") +
  scale_color_nina(name = "Lokalitet")
```




```
seasonAvgNo %>%
  filter(habitat_type == "SN_Gressmark") %>%
ggplot() +
  geom_point(aes(x = date_emptied, y = sum_biomass, color = locality)) +
  geom_line(aes(x = date_emptied, y = sum_biomass, color = locality)) +
  ylab("Total innsamlet biomasse (våtvekt g. pluss flaske)") +
  xlab("Tømmedato") +
  scale_color_nina(name = "Lokalitet")
```



Plot some weather data

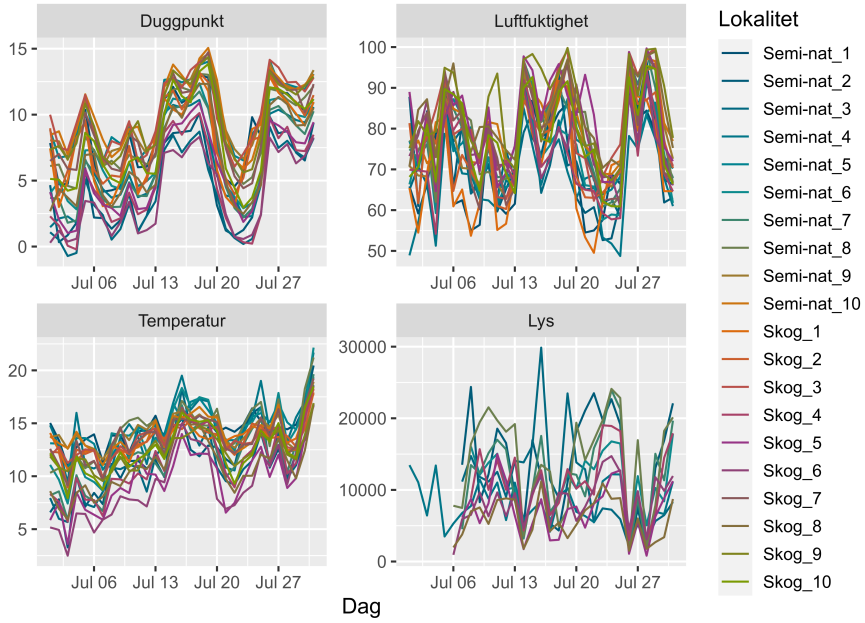
```
logger_tbl <- tbl(con,
                  in_schema("loggers", "logger_data")) %>%
  select(-id)

logger_dep_tbl <- tbl(con,
                  in_schema("loggers", "logger_deployments")) %>%
  select(-id)
```

```
logger_data <- logger_tbl %>%
  left_join(logger_dep_tbl,
            by = c("logger_id" = "logger_id",
                   "logger_type" = "logger_type")) %>%
  mutate(day = as.Date(date))
```

Plot average values for each site during July

```
tt <- logger_data %>%
  group_by(location, day, data_type) %>%
  summarize(value = mean(value)) %>%
  filter(day >= '2020-07-01' &
         day < '2020-08-01'
```

```
        ) %>%
  collect() %>%
  mutate(Lokalitet = factor(location, levels = c(paste0("Semi-nat_", 1:10), paste0("Skog_",
  mutate(data_type = factor(data_type, levels = ))
##Why can't I set the levels in the pipe?
levels(tt$data_type) <- c("Duggpunkt", "Luftfuktighet", "Temperatur", "Lys")

tt %>%
  ggplot(.) +
  geom_line(aes(x = day, y = value, color = Lokalitet)) +
  facet_wrap(~data_type,
             scales = "free") +
  scale_color_nina(name = "Lokalitet") +
  xlab("Dag") +
  ylab("") +
  theme(legend.key.height = unit(0.5, "cm"))
```



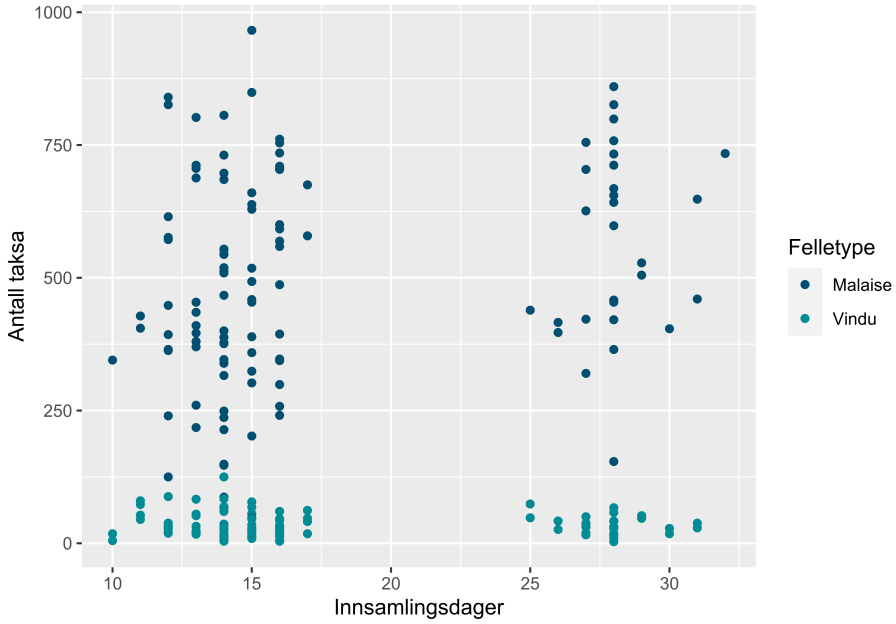
Sampling time analysis

Time to look at the impact of sampling time, 2 vs 4 weeks.

First off, simple plot of species richness against days sampled.

```
dat %>%
  group_by(locality,
           trap,
           trap_type,
           empty_week,
           weeks_sampled,
           days_collected) %>%
  summarise(no_spec = n_distinct(order, family, genus, species)) %>%
  ggplot(aes(x = days_collected, y = no_spec)) +
  geom_point(aes(color = trap_type)) +
  scale_color_nina(name = "Felletype") +
  ylab("Antall taksa") +
  xlab("Innsamlingsdager")
```

```
## `summarise()` regrouping output by 'locality', 'trap', 'trap_type', 'empty_week', 'weeks_
```



Not easy to see any patterns here, since there is such variation in the catches throughout the season. We need to sum up the catches in the 2 2-week periods and compare to the single 4 week periods.

We first identify which of the 2-week samples that should be aggregated.

```
#4-week "target" to agg to
week_4 <- dat %>%
  filter(weeks_sampled == 4) %>%
  select(locality,
```

```
         empty_week) %>%
  distinct() %>%
  mutate(agg_id = 1:n())

#add 2 weeks earlier
earlier_2_weeks <- week_4 %>%
  select(locality,
         agg_id) %>%
  mutate(empty_week = week_4$empty_week - 2)

which_to_agg <- week_4 %>%
  bind_rows(earlier_2_weeks)

#add aggregation ids to 2-week samplings
to_agg <- dat %>%
  filter(weeks_sampled == 2) %>%
  left_join(which_to_agg,
            by = c("locality" = "locality",
                   "empty_week" = "empty_week"))
```

Check which didn't get an aggregation

```
to_agg %>%
  filter(is.na(agg_id)) %>%
  select(locality,
         empty_week,
         trap) %>%
  distinct() %>%
  arrange(empty_week,
          locality) %>%
  print(n = Inf)
```

```
## # A tibble: 46 x 3
##    locality    empty_week trap
##    <fct>            <dbl> <chr>
##  1 Semi-nat_1          24 MF1
##  2 Semi-nat_1          24 MF2
##  3 Semi-nat_10         24 MF1
##  4 Semi-nat_10         24 MF2
##  5 Skog_1              24 MF1
##  6 Skog_1              24 MF2
##  7 Skog_1              24 VF1
##  8 Skog_1              24 VF2
##  9 Skog_1              24 VF3
## 10 Skog_1              24 VF4
## 11 Skog_2              24 MF1
```

```
## 12 Skog_2              24 MF2
## 13 Skog_2              24 VF1
## 14 Skog_2              24 VF2
## 15 Skog_2              24 VF3
## 16 Skog_2              24 VF4
## 17 Semi-nat_1          30 MF1
## 18 Semi-nat_5          30 MF1
## 19 Semi-nat_9          30 MF1
## 20 Semi-nat_10         30 MF1
## 21 Skog_1              30 MF1
## 22 Skog_1              30 VF1
## 23 Skog_1              30 VF3
## 24 Skog_2              30 MF1
## 25 Skog_2              30 VF1
## 26 Skog_2              30 VF3
## 27 Skog_3              30 MF1
## 28 Skog_3              30 VF1
## 29 Skog_3              30 VF3
## 30 Skog_7              30 MF1
## 31 Skog_7              30 VF1
## 32 Skog_7              30 VF3
## 33 Skog_9              30 MF1
## 34 Skog_9              30 VF1
## 35 Skog_9              30 VF3
## 36 Semi-nat_1          32 MF1
## 37 Semi-nat_2          32 MF1
## 38 Semi-nat_4          32 MF1
## 39 Semi-nat_6          32 MF1
## 40 Semi-nat_7          32 MF1
## 41 Semi-nat_8          32 MF1
## 42 Skog_4              32 MF1
## 43 Skog_5              32 MF1
## 44 Skog_6              32 MF1
## 45 Skog_8              32 MF1
## 46 Skog_10             32 MF1
```

The samples from week 24 are expected, since not all traps where set up early enough to get 2 emptyings by then.

```
dat %>%
  filter(locality == 'Semi-nat_2' &
           empty_week == 34) %>%
  select(locality,
         empty_week,
         date_emptied,
         weeks_sampled,
```

```
        trap,
        GenlabID) %>%
  distinct()
```

```
## # A tibble: 0 x 6
## # ... with 6 variables: locality <fct>, empty_week <dbl>, date_emptied <date>,
## #   weeks_sampled <dbl>, trap <chr>, GenlabID <chr>
```

But Semi-nat_1, week_32, trap MF2 should be there. Semi-nat_5 as well. Seems that these haven't been run yet. I'll remove these for the comparison.

```
#Sum the genetic reads to combine the two weeks
agg_data_2_week <- to_agg %>%
  filter(!is.na(agg_id)) %>%
  group_by(locality,
           trap_type,
           trap,
           agg_id,
           species_latin) %>%
  summarise(value = sum(value)) %>%
  ungroup()
```

```
## `summarise()` regrouping output by 'locality', 'trap_type', 'trap', 'agg_id' (override wi
```

```
#Add the week information for the second sampling
agg_data_2_week <- agg_data_2_week %>%
  left_join(week_4,
            by = c("agg_id" = "agg_id",
                   "locality" = "locality")) %>%
  mutate(weeks_sampled = 2) %>%
  select(locality,
         empty_week,
         weeks_sampled,
         trap_type,
         trap,
         species_latin,
         value)


#Select only the original 4 week samplings
data_4_week <- dat %>%
  filter(weeks_sampled == 4) %>%
    select(locality,
           empty_week,
           weeks_sampled,
           trap_type,
           trap,
```

```
            species_latin,
            value)

#Add the original 4 weeks to the summarized 2 2-week samplngs
week_comp_data <- agg_data_2_week  %>%
  bind_rows(data_4_week)
```

Summarise the number of species in both sample lengths.

```
no_species_weeks <- week_comp_data %>%
  group_by(locality,
            empty_week,
            weeks_sampled,
            trap_type) %>%
  summarise(no_species = n())
```

```
## `summarise()` regrouping output by 'locality', 'empty_week', 'weeks_sampled' (override wi
```

```
#Check comparison
no_species_weeks %>%
  group_by(locality,
            empty_week,
            trap_type) %>%
  summarise(no_comp = n()) %>%
  print(n = Inf)
```

```
## `summarise()` regrouping output by 'locality', 'empty_week' (override with `.groups` argu
```

```
## # A tibble: 43 x 4
## # Groups:   locality, empty_week [29]
##    locality    empty_week trap_type no_comp
##    <fct>            <dbl> <chr>       <int>
##  1 Semi-nat_1          28 Malaise         2
##  2 Semi-nat_2          30 Malaise         2
##  3 Semi-nat_3          30 Malaise         2
##  4 Semi-nat_4          26 Malaise         2
##  5 Semi-nat_4          30 Malaise         2
##  6 Semi-nat_5          24 Malaise         2
##  7 Semi-nat_5          28 Malaise         2
##  8 Semi-nat_6          26 Malaise         2
##  9 Semi-nat_6          30 Malaise         2
## 10 Semi-nat_7          30 Malaise         2
## 11 Semi-nat_8          26 Malaise         2
## 12 Semi-nat_8          30 Malaise         2
## 13 Semi-nat_9          24 Malaise         2
## 14 Semi-nat_9          28 Malaise         2
## 15 Semi-nat_10         28 Malaise         2
```

```
## 16 Skog_1              28 Malaise         2
## 17 Skog_1              28 Vindu           2
## 18 Skog_2              28 Malaise         2
## 19 Skog_2              28 Vindu           2
## 20 Skog_3              24 Malaise         2
## 21 Skog_3              24 Vindu           2
## 22 Skog_3              28 Malaise         2
## 23 Skog_3              28 Vindu           2
## 24 Skog_4              30 Malaise         2
## 25 Skog_4              30 Vindu           2
## 26 Skog_5              30 Malaise         2
## 27 Skog_5              30 Vindu           2
## 28 Skog_6              30 Malaise         2
## 29 Skog_6              30 Vindu           2
## 30 Skog_7              24 Malaise         2
## 31 Skog_7              24 Vindu           2
## 32 Skog_7              28 Malaise         2
## 33 Skog_7              28 Vindu           2
## 34 Skog_8              30 Malaise         2
## 35 Skog_8              30 Vindu           2
## 36 Skog_9              24 Malaise         2
## 37 Skog_9              24 Vindu           2
## 38 Skog_9              28 Malaise         2
## 39 Skog_9              28 Vindu           2
## 40 Skog_10             26 Malaise         2
## 41 Skog_10             26 Vindu           2
## 42 Skog_10             30 Malaise         2
## 43 Skog_10             30 Vindu           2
```

Make a comparison table.

```
comp_species_week <- no_species_weeks %>%
  pivot_wider(id_cols = c(locality,
                          empty_week,
                          trap_type),
              names_from = weeks_sampled,
              values_from = no_species,
              names_prefix = "sample_time_") %>%
  mutate(diff_sample_time = sample_time_4 - sample_time_2,
         prc_diff_sample_time = (sample_time_4 - sample_time_2) / sample_time_2)
```

Quality check of a few rows. Seems OK.

```
dat %>%
  filter(locality == "Semi-nat_1" &
           (empty_week == 26 | empty_week == 28) &
           trap == "MF1"
```

```
        ) %>%
  summarize(no_spec = n_distinct(species_latin))
```

```
## # A tibble: 1 x 1
##   no_spec
##     <int>
## 1     776
```

```
dat %>%
  filter(locality == "Semi-nat_5" &
           (empty_week == 22 | empty_week == 24) &
           trap == "MF1"
         ) %>%
  summarize(no_spec = n_distinct(species_latin))
```

```
## # A tibble: 1 x 1
##   no_spec
##     <int>
## 1    1219
```

```
dat %>%
  filter(locality == "Semi-nat_5" &
           (empty_week == 24 ) &
           trap == "MF2"
         ) %>%
  summarize(no_spec = n_distinct(species_latin))
```

```
## # A tibble: 1 x 1
##   no_spec
##     <int>
## 1     648
```

```
dat %>%
  filter(locality == "Semi-nat_6" &
           (empty_week == 26 ) &
           trap == "MF2"
         ) %>%
  summarize(no_spec = n_distinct(species_latin))
```

```
## # A tibble: 1 x 1
##   no_spec
##     <int>
## 1     826
```

```
week_comp_data %>%
  filter(locality == "Semi-nat_5" &
           (empty_week == 24 ) &
           trap == "MF2"
```

```
        ) %>%
  summarize(no_spec = n_distinct(species_latin))
```

```
## # A tibble: 1 x 1
##   no_spec
##     <int>
## 1     648
```

```
no_species_weeks %>%
  filter(locality == "Semi-nat_5" &
           empty_week == 24)
```

```
## # A tibble: 2 x 5
## # Groups:   locality, empty_week, weeks_sampled [2]
##   locality   empty_week weeks_sampled trap_type no_species
##   <fct>           <dbl>         <dbl> <chr>          <int>
## 1 Semi-nat_5         24             2 Malaise         1219
## 2 Semi-nat_5         24             4 Malaise          648
```

```
comp_species_week %>%
  group_by(locality) %>%
  filter(trap_type == "Malaise") %>%
  ggplot(.) +
  geom_point(aes(x = empty_week, y = diff_sample_time, color = locality)) +
  geom_line(aes(x = empty_week, y = diff_sample_time, color = locality)) +
  scale_color_nina(name = "Lokalitet") +
  ylab("Diff. kumulativ 2 uker - 4 uker (no. taksa)") +
  xlab("Tømmingsuke, 4 ukerstømming") +
  geom_hline(yintercept = 0) +
  theme(legend.key.height = unit(0.5, "cm"))
```

```
comp_species_week %>%
  group_by(locality) %>%
  filter(trap_type == "Malaise") %>%
  ggplot(.) +
  geom_point(aes(x = empty_week, y = prc_diff_sample_time, color = locality)) +
  geom_line(aes(x = empty_week, y = prc_diff_sample_time, color = locality)) +
  scale_color_nina(name = "Lokalitet") +
  ylab("% Diff. kumulativ 2 uker - 4 uker") +
  xlab("Tømmingsuke, 4 ukerstømming") +
  geom_hline(yintercept = 0) +
  theme(legend.key.height = unit(0.5, "cm"))
```

```
comp_species_week %>%
  group_by(locality) %>%
  filter(trap_type == "Vindu") %>%
  ggplot(.) +
```

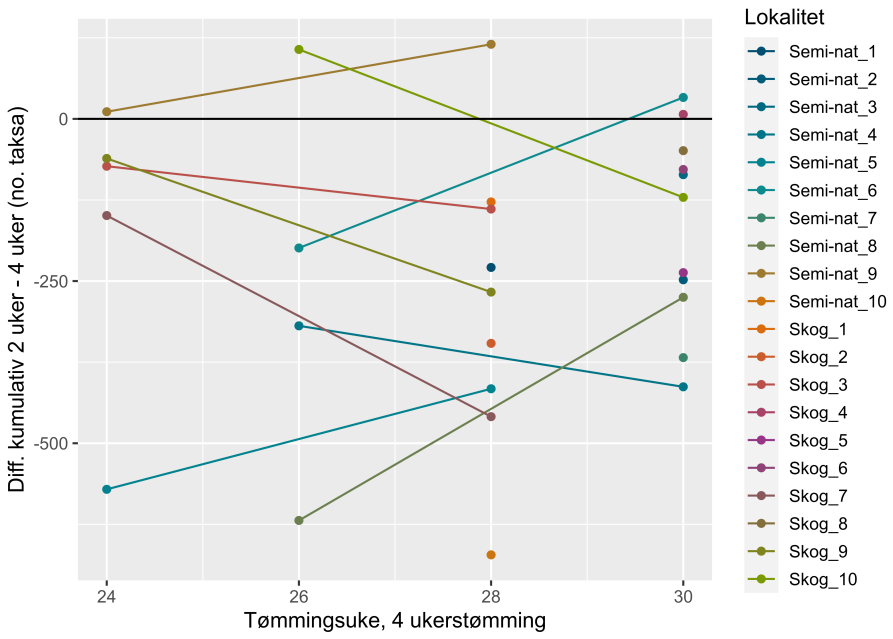


Figure 6: Difference (g.) in cumulative species richness over 2 2-week samplings, compared to 1 4 week sampling. Catch in 1 Malaise trap per period. Negative values indicate that 4-week samplings gave lower insect species richness than the two 2-week samplings.

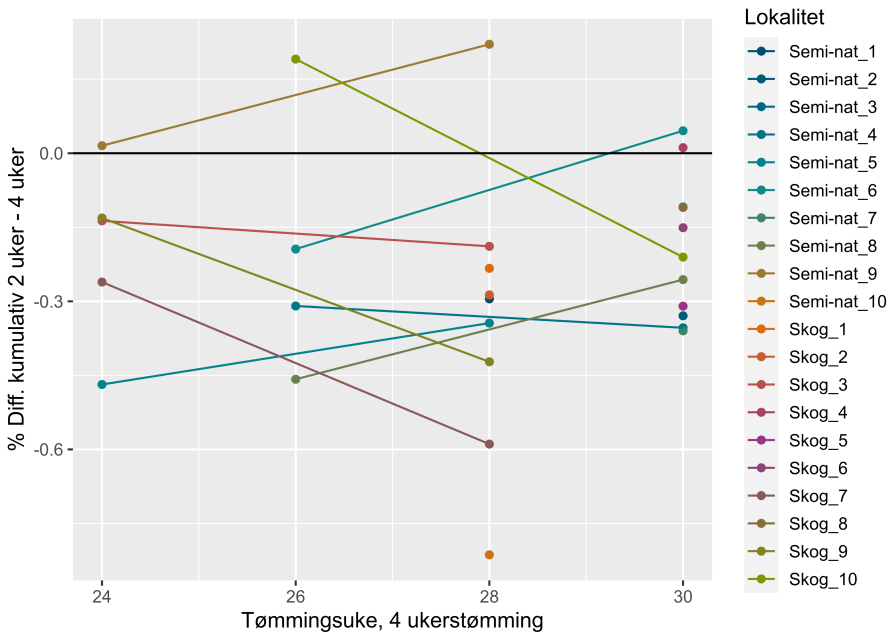


Figure 7: Percentage difference in cumulative species richness over 2 2-week samplings, compared to 1 4 week sampling. Catch in 1 Malaise trap per period. Negative values indicate that 4-week samplings gave lower insect species richness than the two 2-week samplings.

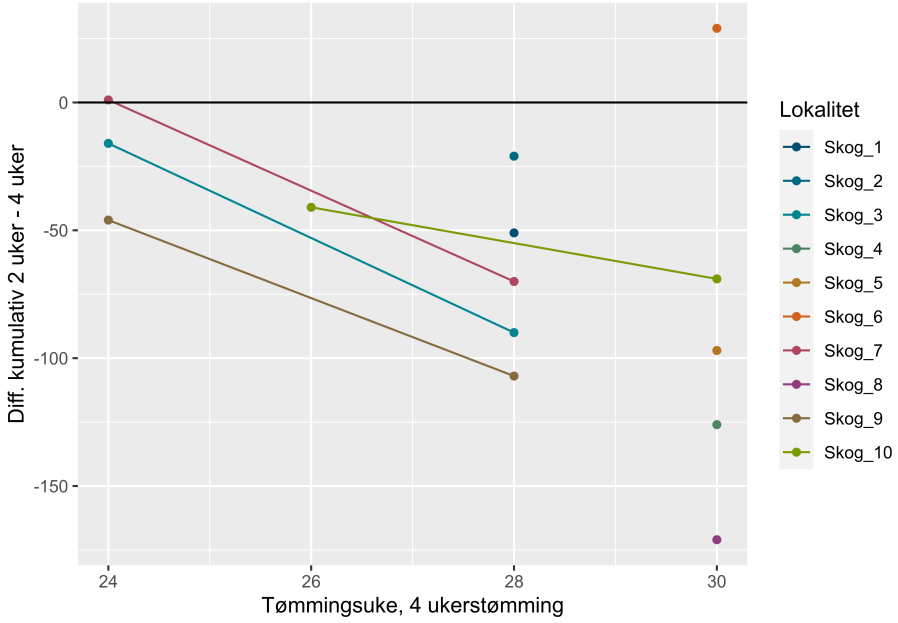


Figure 8: Difference in cumulative species richness over 2 2-week samplings, compared to 1 4 week sampling. Catch in 1 Malaise trap per period. Negative values indicate that 4-week samplings gave lower insect species richness than the two 2-week samplings.

```
  geom_point(aes(x = empty_week, y = diff_sample_time, color = locality)) +
  geom_line(aes(x = empty_week, y = diff_sample_time, color = locality)) +
  scale_color_nina(name = "Lokalitet") +
  ylab("Diff. kumulativ 2 uker - 4 uker") +
  xlab("Tømmingsuke, 4 ukerstømming") +
  geom_hline(yintercept = 0)
```

```
comp_species_week %>%
  group_by(locality) %>%
  filter(trap_type == "Vindu") %>%
  ggplot(.) +
  geom_point(aes(x = empty_week, y = prc_diff_sample_time, color = locality)) +
  geom_line(aes(x = empty_week, y = prc_diff_sample_time, color = locality)) +
  scale_color_nina(name = "Lokalitet") +
  ylab("% Diff. kumulativ 2 uker - 4 uker") +
  xlab("Tømmingsuke, 4 ukerstømming") +
  geom_hline(yintercept = 0)
```

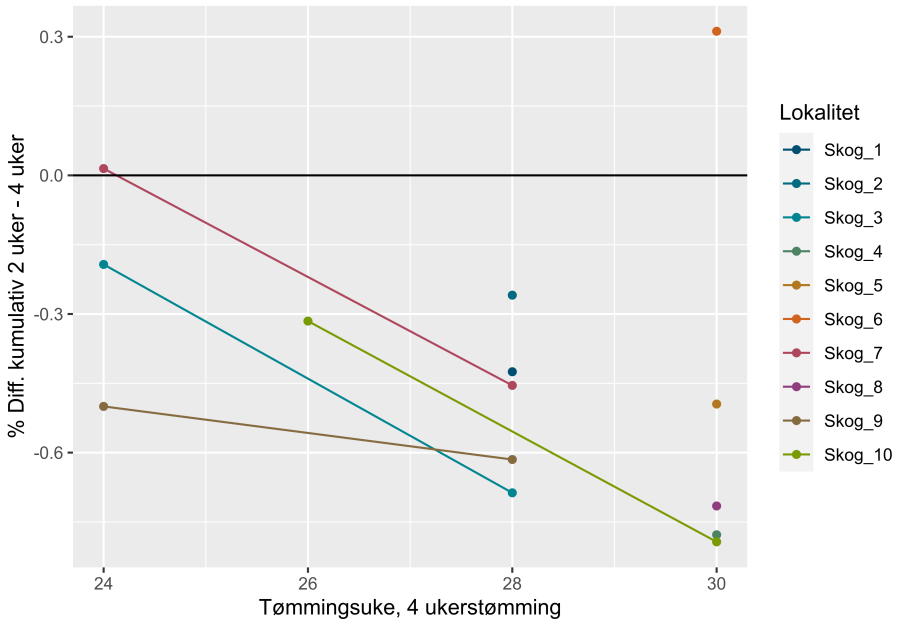


Figure 9: Percentage difference in cumulative species richness over 2 2-week samplings, compared to 1 4 week sampling. Catch in 2 window traps per period. Negative values indicate that 4-week samplings gave lower insect species richness than the two 2-week samplings.

A similar comparison, but for biomass.

```
biomass_agg_data_2_week <- to_agg %>%
  filter(!is.na(agg_id)) %>%
  select(locality,
         empty_week,
           trap_type,
           trap,
           agg_id,
         biomass = Toerrvekt_.g.) %>%
  distinct() %>%
  arrange(locality,
          empty_week,
          trap) %>%
  group_by(locality,
           trap_type,
           agg_id) %>%
  summarise(empty_week = max(empty_week),
            biomass = sum(biomass)
            ) %>%
  ungroup()  %>%
  select(-agg_id)
```

```
## `summarise()` regrouping output by 'locality', 'trap_type' (override with `.groups` argum
```

```
biomass_data_4_week <- dat %>%
  filter(weeks_sampled == 4) %>%
  select(locality,
         empty_week,
         trap_type,
         trap,
         biomass = Toerrvekt_.g.) %>%
  distinct() %>%
  arrange(locality,
          empty_week,
          trap) %>%
    group_by(locality,
             empty_week,
           trap_type) %>%
    summarise(empty_week = max(empty_week),
              biomass = sum(biomass)
              ) %>%
  ungroup()
```

```
## `summarise()` regrouping output by 'locality', 'empty_week' (override with `.groups` argu
```

```
#Make comparison table
biomass_comp <- biomass_agg_data_2_week %>%
  left_join(biomass_data_4_week,
            by = c("locality" = "locality",
                   "empty_week" = "empty_week",
                   "trap_type" = "trap_type"),
            suffix = c("_2_weeks", "_4_weeks")) %>%
  mutate(diff_sample_time = biomass_4_weeks - biomass_2_weeks,
         prc_diff_sample_time = (biomass_4_weeks - biomass_2_weeks) / biomass_2_weeks)
```

```
biomass_comp %>%
  group_by(locality) %>%
  filter(trap_type == "Malaise") %>%
  ggplot(.) +
  geom_point(aes(x = empty_week, y = prc_diff_sample_time, color = locality)) +
  geom_line(aes(x = empty_week, y = prc_diff_sample_time, color = locality)) +
  scale_color_nina(name = "Lokalitet") +
  ylab("% Diff. kumulativ 2 uker - 4 uker") +
  xlab("Tømmingsuke, 4 ukerstømming") +
  geom_hline(yintercept = 0) +
  theme(legend.key.height = unit(0.5, "cm"))
```

```
## Warning: Removed 3 rows containing missing values (geom_point).
```

```
## Warning: Removed 3 row(s) containing missing values (geom_path).
```

We can do the same comparison with wet weight, althought we might expect that this will add some weight of the ethanol and the bottles, which will lead to bias when we sum these together for the 2 weeks. Anyway, this is the way it looks for wet weight.

```
biomass_agg_data_2_week <- to_agg %>%
  filter(!is.na(agg_id)) %>%
  select(locality,
         empty_week,
           trap_type,
           trap,
           agg_id,
         biomass = Vaatvekt_.g.) %>%
  distinct() %>%
  arrange(locality,
          empty_week,
          trap) %>%
  group_by(locality,
           trap_type,
           agg_id) %>%
  summarise(empty_week = max(empty_week),
```

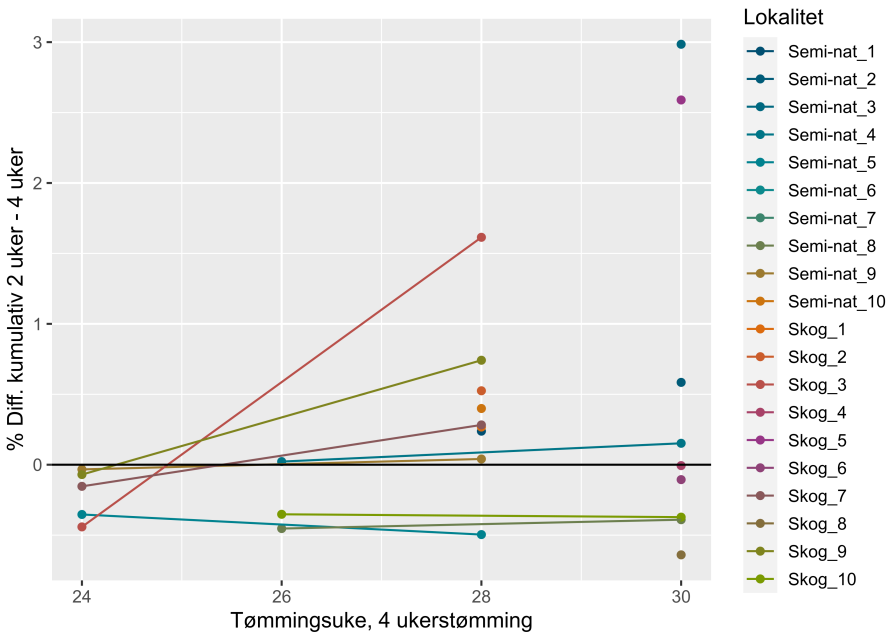


Figure 10: Percentage difference in cumulative dry weight over 2 2-week samplings, compared to 1 4 week sampling. Catch in 1 Malaise trap per period. Negative values indicate that 4-week samplings gave lower insect species richness than the two 2-week samplings.

```
            biomass = sum(biomass)
            ) %>%
  ungroup()  %>%
  select(-agg_id)
```

```
## `summarise()` regrouping output by 'locality', 'trap_type' (override with `.groups` argum
```

```
biomass_data_4_week <- dat %>%
  filter(weeks_sampled == 4) %>%
  select(locality,
         empty_week,
         trap_type,
         trap,
         biomass = Vaatvekt_.g.) %>%
  distinct() %>%
  arrange(locality,
          empty_week,
          trap) %>%
    group_by(locality,
             empty_week,
           trap_type) %>%
    summarise(empty_week = max(empty_week),
            biomass = sum(biomass)
            ) %>%
  ungroup()
```

```
## `summarise()` regrouping output by 'locality', 'empty_week' (override with `.groups` argu
```

```
#Make comparison table
biomass_comp <- biomass_agg_data_2_week %>%
  left_join(biomass_data_4_week,
            by = c("locality" = "locality",
                   "empty_week" = "empty_week",
                   "trap_type" = "trap_type"),
            suffix = c("_2_weeks", "_4_weeks")) %>%
  mutate(diff_sample_time = biomass_2_weeks - biomass_4_weeks,
         prc_diff_sample_time = (biomass_2_weeks - biomass_4_weeks) / biomass_2_weeks)
```

```
biomass_comp %>%
  group_by(locality) %>%
  filter(trap_type == "Malaise") %>%
  ggplot(.) +
  geom_point(aes(x = empty_week, y = prc_diff_sample_time, color = locality)) +
  geom_line(aes(x = empty_week, y = prc_diff_sample_time, color = locality)) +
  scale_color_nina(name = "Lokalitet") +
  ylab("% Diff. kumulativ 2 uker - 4 uker") +
  xlab("Tømmingsuke, 4 ukerstømming") +
```

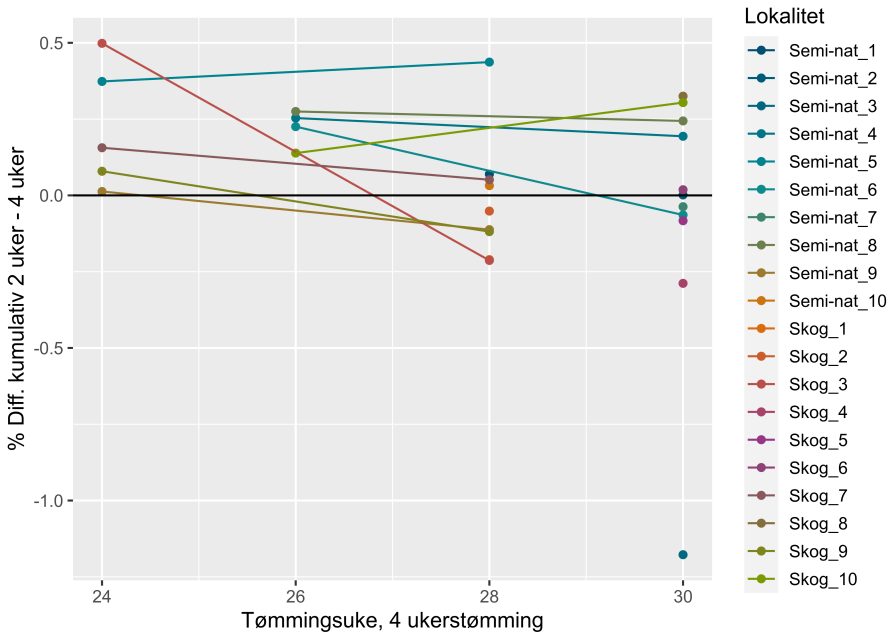


Figure 11: Percentage difference in cumulative wet weight over 2 2-week samplings, compared to 1 4 week sampling. Catch in 1 Malaise trap per period. Negative values indicate that 4-week samplings gave lower insect species richness than the two 2-week samplings.

```
  geom_hline(yintercept = 0) +
  theme(legend.key.height = unit(0.5, "cm"))
```

Compare the ethanol to the propglykol window traps

```
liquid_comp <- dat %>%
  filter(trap_type == "Vindu") %>%
  group_by(locality,
           trap,
           liquid,
           weeks_sampled,
           empty_week,
           sample_id
           ) %>%
  summarise(no_species = n_distinct(species_latin))
```

```
## `summarise()` regrouping output by 'locality', 'trap', 'liquid', 'weeks_sampled', 'empty_
```

```
liquid_comp
```

```
## # A tibble: 101 x 7
## # Groups:   locality, trap, liquid, weeks_sampled, empty_week [101]
##    locality trap  liquid      weeks_sampled empty_week sample_id      no_species
##    <fct>    <chr> <chr>               <dbl>      <dbl> <chr>               <int>
##  1 Skog_1   VF1   Ethanol                 2         24 skog_1_VF1_we~         43
##  2 Skog_1   VF1   Ethanol                 2         26 skog_1_VF1_we~         31
##  3 Skog_1   VF1   Ethanol                 2         28 skog_1_VF1_we~         30
##  4 Skog_1   VF1   Ethanol                 2         30 skog_1_VF1_we~         27
##  5 Skog_1   VF2   Ethanol                 2         24 skog_1_VF2_we~         60
##  6 Skog_1   VF2   Ethanol                 4         28 skog_1_VF2_we~         28
##  7 Skog_1   VF3   PropGl_Eth~             2         24 skog_1_VF3_we~         46
##  8 Skog_1   VF3   PropGl_Eth~             2         26 skog_1_VF3_we~         31
##  9 Skog_1   VF3   PropGl_Eth~             2         28 skog_1_VF3_we~         46
## 10 Skog_1   VF3   PropGl_Eth~             2         30 skog_1_VF3_we~         18
## # ... with 91 more rows
```

```
liquid_mod_0 <- glmer(no_species ~ liquid * weeks_sampled + (1|empty_week) + (1 | locality),
                      family = "poisson",
                      data = liquid_comp)

isSingular(liquid_mod_0)
```

```
## [1] FALSE
```

```
summary(liquid_mod_0)
```

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: poisson  ( log )
## Formula: no_species ~ liquid * weeks_sampled + (1 | empty_week) + (1 |
##     locality)
##    Data: liquid_comp
##
##      AIC      BIC   logLik deviance df.resid
##   1620.7   1636.4   -804.4   1608.7       95
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -5.8003 -2.5318 -0.8503  2.0783 10.6207
##
## Random effects:
##  Groups     Name        Variance Std.Dev.
```

```
##  locality   (Intercept) 0.08466  0.2910
##  empty_week (Intercept) 0.05510  0.2347
## Number of obs: 101, groups:  locality, 10; empty_week, 5
##
## Fixed effects:
##                                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)                        3.62137    0.15886  22.797   <2e-16 ***
## liquidPropGl_Ethanol              -0.03270    0.10194  -0.321    0.748
## weeks_sampled                     -0.04275    0.02861  -1.494    0.135
## liquidPropGl_Ethanol:weeks_sampled  0.04058    0.03826   1.061    0.289
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) lqPG_E wks_sm
## lqdPrpGl_Et -0.342
## weeks_smpld -0.438  0.679
## lqdPrpG_E:_  0.328 -0.944 -0.728
```

I struggle to model this with all the random effect I would like. I'm not able to include a id level random effect to account for overdispersion for example. Anyway, the results give an indication of the differences in the data.

```
liquid_pred <- ggpredict(liquid_mod_0,
                         terms = c("liquid", "weeks_sampled"))
```

```
plot(liquid_pred) +
  scale_color_nina(name = "Antall uker") +
  ggtitle("") +
  ylab("Antall taksa") +
  xlab("Væske i vindusfelle")
```

```
## Scale for 'colour' is already present. Adding another scale for 'colour',
## which will replace the existing scale.
```

Ano-registations

Here is some simple graphs of the ANO measurements at the locations. IKKE KLAR, gjør bedre fargeskala

```
ano_arter <- tbl(con,
                 in_schema("ano", "herb_species"))
```

```
## Warning in postgresqlExecStatement(conn, statement, ...): RS-DBI driver warning:
## (unrecognized PostgreSQL field type uuid (id:2950) in column 0)
```

```
## Warning in postgresqlExecStatement(conn, statement, ...): RS-DBI driver warning:
```

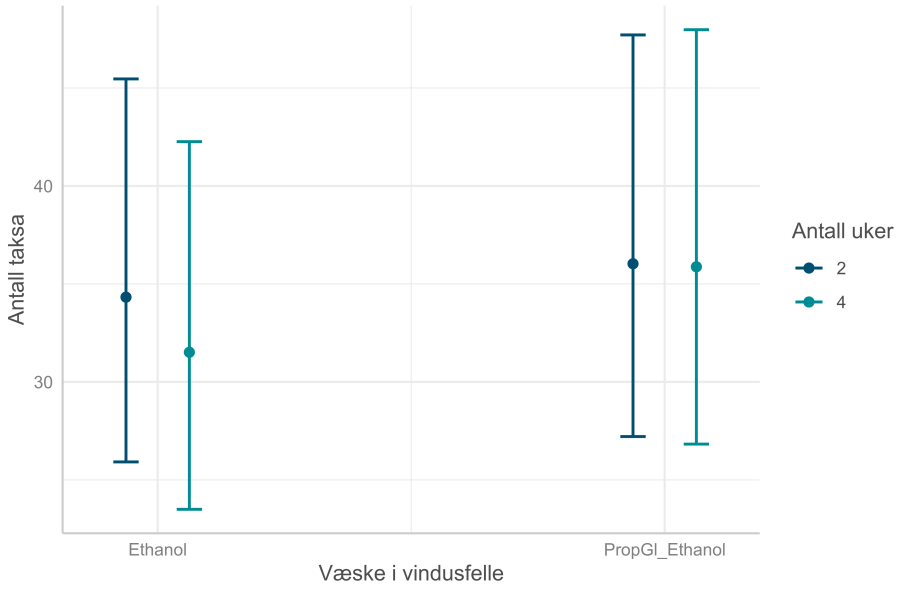


Figure 12: Modelled difference in number of taxa found in window traps, in 2/4 weeks sampling and ethanol/propylen-glycole liquid.

```
## (unrecognized PostgreSQL field type uuid (id:2950) in column 1)
```

```
ano_plots <- tbl(con,
                 in_schema("ano", "survey_points"))
```

```
## Warning in postgresqlExecStatement(conn, statement, ...): RS-DBI driver warning:
## (unrecognized PostgreSQL field type uuid (id:2950) in column 0)
```

```
## Warning in postgresqlExecStatement(conn, statement, ...): RS-DBI driver warning:
## (unrecognized PostgreSQL field type geometry (id:14917875) in column 56)
```

```
## Warning in postgresqlExecStatement(conn, statement, ...): RS-DBI driver warning:
## (unrecognized PostgreSQL field type geometry (id:14917875) in column 57)
```

```
trap_loc <- tbl(con,
                in_schema("traps", "locations"))
```

```
## Warning in postgresqlExecStatement(conn, statement, ...): RS-DBI driver warning:
## (unrecognized PostgreSQL field type uuid (id:2950) in column 0)
```

```
  trap_loc %>%
  left_join(ano_plots,
            by = c("ano_flate_id" = "ano_flate_id")) %>%
  select(-c(geom_punched, geom_inferred)) %>%
  collect() %>%
  select(location, ano_flate_id, global_id) %>%
  distinct() %>%
  print(n = Inf)
```

```
## Warning in postgresqlExecStatement(conn, statement, ...): RS-DBI driver warning:
## (unrecognized PostgreSQL field type uuid (id:2950) in column 0)
```

```
## Warning in postgresqlExecStatement(conn, statement, ...): RS-DBI driver warning:
## (unrecognized PostgreSQL field type uuid (id:2950) in column 4)
```

```
## # A tibble: 170 x 3
##     location    ano_flate_id global_id
##     <chr>       <chr>        <chr>
##   1 Semi-nat_1  ANO2090      8f1e3337-2266-a776-2ec4-fe1a20f07a91
##   2 Semi-nat_2  ANO4425      b2720789-9d0b-5c40-5ca5-f864591c3d5d
##   3 Semi-nat_3  ANO3017      dc774f76-2002-3861-4017-cd66781e422c
##   4 Semi-nat_4  ANO4145      a823bb2b-610e-35be-7ff3-bd9e263e6a31
##   5 Semi-nat_5  ANO2860      5f760aec-1aa6-1e10-7da1-71808f893bf2
##   6 Semi-nat_6  ANO9774      3c34ac4e-0788-50d9-083a-b8f304166fb0
##   7 Semi-nat_7  ANO4095      53a2a769-81d0-6b51-0067-e50172392a45
##   8 Semi-nat_8  ANO6685      6fc6939b-7a55-a074-103d-e7b9b3db09cb
##   9 Semi-nat_9  ANO7399      e14b08a6-2b17-351a-4b7b-c9445dbea181
##  10 Semi-nat_10 ANO5494      17d0299b-1faa-a090-4403-14b89881572c
##  11 Skog_1      ANO1092      <NA>
##  12 Skog_2      ANO0958      eacac0ce-c530-4f9b-937f-cf7cdc0a1064
```

```
##  13 Skog_2      ANO0958      98f01570-3899-437c-bc48-b9355ecd77c3
##  14 Skog_2      ANO0958      b17315da-ef8b-4ce3-b9f3-ab9f9a7fddde
##  15 Skog_2      ANO0958      d0646269-56ad-453f-9ec3-261763560a69
##  16 Skog_2      ANO0958      1ba7dd73-c290-458c-b90a-ec313ee56a24
##  17 Skog_2      ANO0958      00151f09-c2ea-4904-bbb8-ee51d338e07f
##  18 Skog_2      ANO0958      1d68691b-3139-4691-9267-7562ef6383c9
##  19 Skog_2      ANO0958      d96414d1-f1bb-4cbf-b5b8-87fbd42681b1
##  20 Skog_2      ANO0958      74367c02-3c1d-4c3f-84d8-9c11a46adb9b
##  21 Skog_2      ANO0958      438ae2c4-fa3a-4eb1-a77b-a5139189659a
##  22 Skog_2      ANO0958      1eed14ae-2406-4e3d-9c13-b789ac047eee
##  23 Skog_2      ANO0958      36d5710d-4f81-474c-8b84-6be1478004a7
##  24 Skog_2      ANO0958      b277acfe-2984-4e77-939f-56749c3d3185
##  25 Skog_2      ANO0958      0aace735-6935-415b-913c-44e2f5f68322
##  26 Skog_2      ANO0958      8395488c-816c-4360-9525-18a16aaf2e9e
##  27 Skog_2      ANO0958      d625e9be-1839-4dcb-8546-750aae4efd44
##  28 Skog_3      ANO0426      50d47680-b9fd-447d-9823-5fb7e2f0fa22
##  29 Skog_3      ANO0426      9b6d609d-07d1-4e2f-92ba-14d60f09c2ff
##  30 Skog_3      ANO0426      af4d5bf6-0687-47e5-8af8-568f511f8889
##  31 Skog_3      ANO0426      4f122810-a082-4449-9c0c-6b5e60bf56f3
##  32 Skog_3      ANO0426      7f1f588c-3d05-40ac-a706-8396530c4c9f
##  33 Skog_3      ANO0426      bf617829-9a06-426d-b935-63570717a28c
##  34 Skog_3      ANO0426      3a8edc11-afd8-4537-8da8-c902067c8d83
##  35 Skog_3      ANO0426      bb8d62af-1f1c-4143-8e35-ade2259a5b52
##  36 Skog_3      ANO0426      ba3f3fee-0612-4e4e-a076-990e792e2494
##  37 Skog_3      ANO0426      4a93708b-6cd0-4a97-97bc-217482cb74d8
##  38 Skog_3      ANO0426      82c85b12-b13c-4316-a0c3-9c6f2f54957a
##  39 Skog_3      ANO0426      bb957353-9dac-4167-a3ea-41e34367571d
##  40 Skog_3      ANO0426      d8f16f8b-01ae-430e-b5a7-163ee8f1cee2
##  41 Skog_3      ANO0426      f6154d42-2f83-4464-a360-faac441a917a
##  42 Skog_3      ANO0426      a4c5252f-92f2-4784-8a26-b9aff0f7dba8
##  43 Skog_3      ANO0426      10663364-b8f5-48e2-921d-6b3fafd0ca77
##  44 Skog_3      ANO0426      bad8d4b5-199f-4b07-af45-7cbfdffc99fa
##  45 Skog_3      ANO0426      44fa14e7-6e64-40bc-98f8-d1bcce55895d
##  46 Skog_4      ANO0574      6fbc273f-d59b-4fc4-94f6-e6426f74d95a
##  47 Skog_4      ANO0574      86319924-3495-4572-b01c-86d0ebab2417
##  48 Skog_4      ANO0574      3adaf83f-d835-4a26-ab73-6ebac96af38b
##  49 Skog_4      ANO0574      ebc51dc9-3842-4a20-8360-3a60c66abc5a
##  50 Skog_4      ANO0574      1c2f25d0-2d5e-4aab-9724-cf84a125ff4a
##  51 Skog_4      ANO0574      fa7381bd-4323-48b6-b3c4-0acbac553c77
##  52 Skog_4      ANO0574      373ac331-911c-4359-8b95-1623d19aa6dc
##  53 Skog_4      ANO0574      0d3022e5-182d-4838-87c5-ad800511fcdd
##  54 Skog_4      ANO0574      1427d114-6db8-4078-a673-82567b270251
##  55 Skog_4      ANO0574      7fca1212-c746-45cc-89c4-ff68623bc25c
##  56 Skog_4      ANO0574      9618245a-9c95-4807-a6cb-0c5dabe567db
##  57 Skog_4      ANO0574      1efd2baf-fc92-4d32-8ac2-d63e11221f8c
##  58 Skog_4      ANO0574      c6cb52dd-fa15-4679-969e-aac737feb040
```

```
##  59 Skog_4      ANO0574      87535e15-9fb9-4966-8e25-6afd45c4b07b
##  60 Skog_4      ANO0574      eeb6f92c-b48b-4e9f-b47d-63e636cbccae
##  61 Skog_4      ANO0574      f32db2c5-9446-48e2-8e55-d935af463f53
##  62 Skog_4      ANO0574      8a281e97-f73e-4186-9253-855d6d0001d9
##  63 Skog_5      ANO0800      cc27776b-2fbd-49ac-9a84-a0ada7c072c8
##  64 Skog_5      ANO0800      b43fd424-9a27-42b5-97ce-31e48a8da2a8
##  65 Skog_5      ANO0800      8f11d82c-327f-4417-9650-50d139b68acc
##  66 Skog_5      ANO0800      5e58b79d-783e-49d2-8105-115d5ad3c97f
##  67 Skog_5      ANO0800      8f472294-92cd-4c86-b563-f4023633646b
##  68 Skog_5      ANO0800      6adeaa18-9172-4cfc-bfd4-4bf9d2d2d40f
##  69 Skog_5      ANO0800      d8f5eb87-9fa1-41aa-8c7f-f4f6cabd784a
##  70 Skog_5      ANO0800      558e0857-02b1-4e26-80a7-d7874af78fb7
##  71 Skog_5      ANO0800      2e751260-2c79-4223-85f3-3b389b5dd623
##  72 Skog_5      ANO0800      eae98d16-8b5e-40a4-afa7-93fb9f4493c2
##  73 Skog_5      ANO0800      4b617538-df95-4ed6-87a3-45c324c765c7
##  74 Skog_5      ANO0800      1b290a93-a182-43d4-aa5a-7a1c815fa4e3
##  75 Skog_5      ANO0800      48de301a-6814-4ad1-ab8f-825b2f749929
##  76 Skog_5      ANO0800      14d75cf1-b06c-4371-94fd-5c988771daf1
##  77 Skog_5      ANO0800      4d4b70c8-5856-4348-a0fd-008927488d1b
##  78 Skog_5      ANO0800      51ff49da-2371-4abc-b5e4-e30313de6108
##  79 Skog_5      ANO0800      f9953dce-3264-43f0-a59e-ed6045ca3626
##  80 Skog_5      ANO0800      6943555f-ae71-4210-8ebe-c1f6d628c415
##  81 Skog_6      ANO0856      ad910f07-604e-41c6-b0d9-9cd8a31b2185
##  82 Skog_6      ANO0856      2b4e63fb-319f-446d-9637-a0dc05a2604e
##  83 Skog_6      ANO0856      9bb6eef8-8d05-435d-b1e0-8d8ab84681a7
##  84 Skog_6      ANO0856      c4e7bdb1-6b6e-4dbb-ad46-e1dc64dccd4e
##  85 Skog_6      ANO0856      6939e70b-6844-47f8-bcef-61c0b30bde87
##  86 Skog_6      ANO0856      43fb5f6b-6d6a-44d8-8f2a-3dea56177674
##  87 Skog_6      ANO0856      58ac69c7-e288-4f26-9bf5-0232183c4adf
##  88 Skog_6      ANO0856      8eb7f451-82af-4c68-aeaf-770c2ee40f1a
##  89 Skog_6      ANO0856      ced9ff6f-46e6-4225-b6b5-0fac3a4eb26c
##  90 Skog_6      ANO0856      c34b72b3-2c0d-4a90-aab5-3469b685efe3
##  91 Skog_6      ANO0856      094d7455-5849-45bb-818e-13d6d7a565aa
##  92 Skog_6      ANO0856      0b345076-5109-40f6-9bd2-99324c1f541d
##  93 Skog_6      ANO0856      cd32c1ad-efcb-4688-9509-b13c1eadb9e8
##  94 Skog_6      ANO0856      a011438c-33a6-4ad7-aebb-1b64a34779a2
##  95 Skog_6      ANO0856      034e1f5e-c02c-4465-849a-2937a59afaa0
##  96 Skog_6      ANO0856      ad30cab3-8320-4905-9120-22915ac57e4c
##  97 Skog_6      ANO0856      81e3fe2b-24b2-4208-aad7-614da78aed48
##  98 Skog_6      ANO0856      180007e6-37f7-464b-804c-4a01f24cc680
##  99 Skog_7      ANO0534      4b0f9cc3-4529-437e-b95b-2def395159b9
## 100 Skog_7      ANO0534      c2a914ca-75ca-4a2b-88d3-c7eefdb86bea
## 101 Skog_7      ANO0534      0ff427a1-1ec5-43b1-bb8d-f283f07b56b6
## 102 Skog_7      ANO0534      ad708040-36e6-46c9-94df-ad1578bc3018
## 103 Skog_7      ANO0534      d9a35b41-851a-44cf-9f2b-183a981f19cc
## 104 Skog_7      ANO0534      b69221c3-6525-478c-878d-a4ae79c233d7
```

```
## 105 Skog_7      ANO0534      e094d311-57fd-40f7-add9-c0a8f576c44e
## 106 Skog_7      ANO0534      a8af17f8-ea1a-41cf-bc77-e548eb22a575
## 107 Skog_7      ANO0534      ac84b604-b999-40ee-af2c-c3e3757c2b01
## 108 Skog_7      ANO0534      f1369211-4763-414b-9704-3ab816340ef9
## 109 Skog_7      ANO0534      8cc22e10-b412-4788-8c15-2015578b7e9e
## 110 Skog_7      ANO0534      3a11ab54-aa71-431c-b7ec-a0d1f25c17f6
## 111 Skog_7      ANO0534      b6fd6696-e5fc-4016-a8d0-a190d2825922
## 112 Skog_7      ANO0534      a510b524-b803-472c-b311-1b5db9807595
## 113 Skog_7      ANO0534      19fb1513-ef46-4a32-9f76-2cbdaccb6999
## 114 Skog_7      ANO0534      6828fd28-2a82-4098-8244-354996b65c63
## 115 Skog_7      ANO0534      fd53364a-f6b4-433f-b782-4f98f35754c7
## 116 Skog_7      ANO0534      039d8eb8-779a-4c19-bbb1-ec62544c21cb
## 117 Skog_8      ANO0051      397ab2fc-7719-4235-8fa9-f4937591f991
## 118 Skog_8      ANO0051      d76b3990-0d7f-4915-8ad1-85b634536148
## 119 Skog_8      ANO0051      6c249d32-46f1-4250-b060-db1d9e8de3ed
## 120 Skog_8      ANO0051      3d32b4a0-3e4d-4318-ad24-4e84894aca08
## 121 Skog_8      ANO0051      9327696f-407e-4938-b418-d6989d530a26
## 122 Skog_8      ANO0051      8ae13c78-2821-48f7-8eae-8f5d271aa950
## 123 Skog_8      ANO0051      1b69394d-c000-4a35-b403-33b64c9deb69
## 124 Skog_8      ANO0051      4a06f6f3-d677-45ed-98b9-236c6972763d
## 125 Skog_8      ANO0051      0c168294-1f84-47f5-a8a6-c06785bf46a0
## 126 Skog_8      ANO0051      93605b59-a4e8-4d3e-8ff1-a55e19b67b8c
## 127 Skog_8      ANO0051      829b6c69-ccbe-47ab-a9aa-0aa7ec31ef81
## 128 Skog_8      ANO0051      4e01548f-5311-445b-be8c-adc57f98eb39
## 129 Skog_8      ANO0051      dc8d0099-aa14-4f05-8869-afad40591484
## 130 Skog_8      ANO0051      0a2250f4-16a0-48d9-85e0-1e8e8f7b3ec0
## 131 Skog_8      ANO0051      a9417c27-0554-436e-94ca-4a1dfe4d7a8a
## 132 Skog_8      ANO0051      324ba37b-160e-4413-ad23-c697fba387b7
## 133 Skog_8      ANO0051      2ea4d8ff-06b2-4ea4-9525-810969d7beed
## 134 Skog_8      ANO0051      d6e6b5e2-d9f8-49aa-b014-2796acd67417
## 135 Skog_9      ANO0914      6fd9b9d2-7893-473a-8b67-a2ba398414a7
## 136 Skog_9      ANO0914      f5b9b0fe-7b48-42e9-88a1-a8b3c04f488a
## 137 Skog_9      ANO0914      8f15d6e3-97c1-458d-8b42-4d12362fdbfa
## 138 Skog_9      ANO0914      95838ef7-551b-48d5-af85-15c0df6621de
## 139 Skog_9      ANO0914      5c42ec16-88df-4323-80e5-571a980326cf
## 140 Skog_9      ANO0914      98ee5314-56ec-4d86-94ae-bcab139e5249
## 141 Skog_9      ANO0914      bac49f20-4048-4e00-a9a4-d07153e04bea
## 142 Skog_9      ANO0914      d9c1aafb-41a7-469e-8454-ce9b8423962a
## 143 Skog_9      ANO0914      a5868ed4-cd56-4367-a7c0-5c32ce3ad416
## 144 Skog_9      ANO0914      d41ed974-ff53-4a64-b0cc-326d990374a8
## 145 Skog_9      ANO0914      39f6b55f-ed5f-4389-8d8d-602b3baf1be8
## 146 Skog_9      ANO0914      106ce33d-3612-4577-bd37-a09331a2044d
## 147 Skog_9      ANO0914      f59861bf-ad43-4c2c-a032-f44a15ed8534
## 148 Skog_9      ANO0914      9660d2c0-099f-4091-8ce2-d5debfa10c73
## 149 Skog_9      ANO0914      737f80e4-c9db-4c3f-ae0a-23699803a968
## 150 Skog_9      ANO0914      2e07c31a-4f0f-44df-b103-e7982bf09f92
```

```
## 151 Skog_9      ANO0914      82f4e1bc-4746-4823-a1eb-4cdc83ccee43
## 152 Skog_9      ANO0914      d962d6ac-be4e-4046-893d-9b94779e497c
## 153 Skog_10     ANO0588      694fab07-c095-49ac-b64a-609a21ccc417
## 154 Skog_10     ANO0588      6e0eba4e-0414-4e12-b0cc-ecc4939bb4cb
## 155 Skog_10     ANO0588      ac660d80-ed6a-4d2a-9dc7-b7ac78ecc0fd
## 156 Skog_10     ANO0588      9702fadb-81de-4a6f-8e69-fda7ecd517a1
## 157 Skog_10     ANO0588      a299825e-dcbb-4af8-95a9-2ccd260b254f
## 158 Skog_10     ANO0588      bb0c08db-1a6a-4cad-a766-6bedaed5bc04
## 159 Skog_10     ANO0588      2a4e885f-67fc-47da-ad3e-e32c8e72257f
## 160 Skog_10     ANO0588      56800450-c3c7-4df6-a0f4-e71d69a36e15
## 161 Skog_10     ANO0588      f43ebd65-a5ef-4d5b-9ab9-42bf205b2bc0
## 162 Skog_10     ANO0588      21b60b22-89ed-46df-ae03-0b094defaf63
## 163 Skog_10     ANO0588      007a3d44-309c-4863-b4bc-431809da3da3
## 164 Skog_10     ANO0588      21d064e7-11ca-45f6-9136-681ef02d14c0
## 165 Skog_10     ANO0588      47bdc52d-d8a5-43cd-8612-d41024c8db70
## 166 Skog_10     ANO0588      65c73bf7-ea26-44b6-9749-326a9c54fb0a
## 167 Skog_10     ANO0588      a83d70e8-29b1-4636-b503-22651f6c1b7a
## 168 Skog_10     ANO0588      d07bc0e7-5aa1-452a-8b63-f2836ad71c7d
## 169 Skog_10     ANO0588      fafc9d24-81f3-40cc-8ab5-4477e63b0844
## 170 Skog_10     ANO0588      07b69d68-5258-4e98-ab1f-cb42ddea616a
```

```
ano_herb_spec <-  trap_loc %>%
  left_join(ano_plots,
            by = c("ano_flate_id" = "ano_flate_id")) %>%
  left_join(ano_arter,
            by = c("global_id" = "parent_global_id")) %>%
  select(-c(geom_punched, geom_inferred)) %>%
  collect()
```

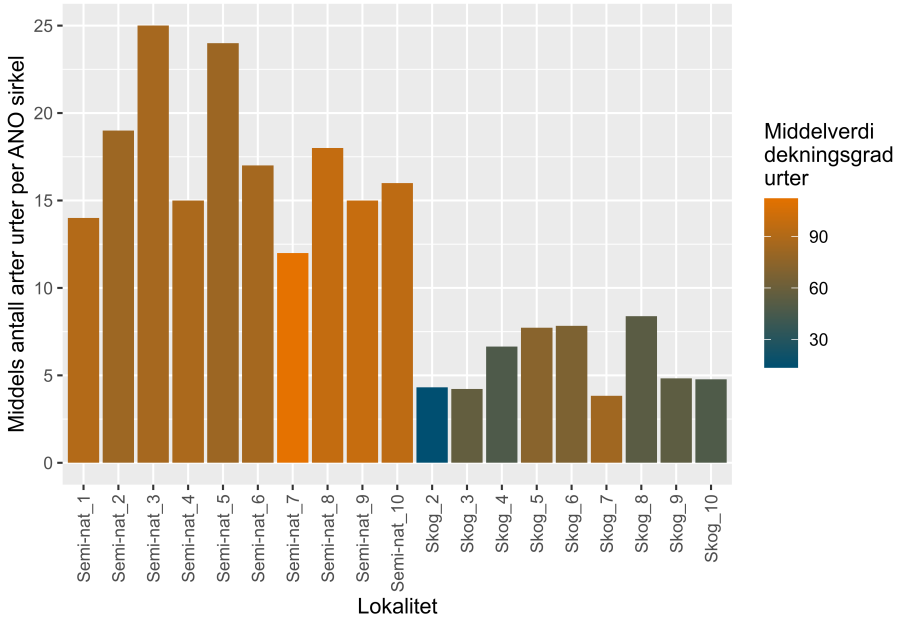
```
## Warning in postgresqlExecStatement(conn, statement, ...): RS-DBI driver warning:
## (unrecognized PostgreSQL field type uuid (id:2950) in column 0)

## Warning in postgresqlExecStatement(conn, statement, ...): RS-DBI driver warning:
## (unrecognized PostgreSQL field type uuid (id:2950) in column 4)

## Warning in postgresqlExecStatement(conn, statement, ...): RS-DBI driver warning:
## (unrecognized PostgreSQL field type uuid (id:2950) in column 59)
```

```
ano_agg <- ano_herb_spec %>%
  group_by(global_id.x) %>%
  summarize(location = first(location),
            no_spec = n_distinct(navn),
            cover = sum(dekning_prc, na.rm = T)) %>%
  group_by(location) %>%
  summarise(mean_no_spec = mean(no_spec),
            mean_cover = mean(cover)) %>%
  collect() %>%
```

```
  mutate(location = factor(location, levels = c(paste0("Semi-nat_", 1:10), paste0("Skog_",1:
  filter(location != "Skog_1")
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
## `summarise()` ungrouping output (override with `.groups` argument)
```

```
ano_agg %>%
  ggplot(.) +
  geom_bar(aes(x = location, y = mean_no_spec, fill = mean_cover), stat = "identity") +
  scale_fill_nina(name = "Middelverdi\ndekningsgrad\nurter",
                  discrete = F,
                  palette = "darkblue-orange") +
  ylab("Middels antall arter urter per ANO sirkel") +
  xlab("Lokalitet") +
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1))
```



Forest-registrations

Some simple graphs of the forest registrations.

```
tree_reg <- tbl(con,
                in_schema("landsskog", "survey_data"))
```

```
## Warning in postgresqlExecStatement(conn, statement, ...): RS-DBI driver warning:
```

```
## (unrecognized PostgreSQL field type uuid (id:2950) in column 0)
```

```
## Warning in postgresqlExecStatement(conn, statement, ...): RS-DBI driver warning:
## (unrecognized PostgreSQL field type uuid (id:2950) in column 1)
```

```
tree_plots <- tbl(con,
                  in_schema("landsskog", "survey_points"))
```

```
## Warning in postgresqlExecStatement(conn, statement, ...): RS-DBI driver warning:
## (unrecognized PostgreSQL field type uuid (id:2950) in column 0)
```

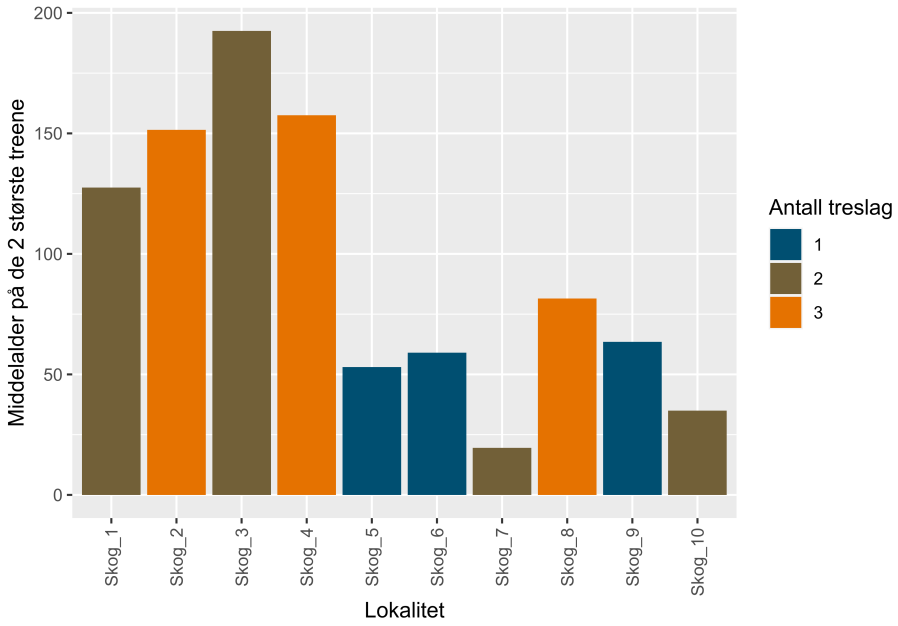
```
trap_loc <- tbl(con,
                  in_schema("traps", "locations"))
```

```
## Warning in postgresqlExecStatement(conn, statement, ...): RS-DBI driver warning:
## (unrecognized PostgreSQL field type uuid (id:2950) in column 0)
```

```
tree_spec <- tree_reg %>%
  left_join(tree_plots,
            by = c("parent_id" = "id")) %>%
  left_join(trap_loc,
            by = c("ano_flate_id" = "ano_flate_id"))
```

```
tree_agg <- tree_spec %>%
  group_by(location) %>%
  summarize(no_spec = as.character(n_distinct(treslag)),
            avg_age = mean(alder, na.rm = T)) %>%
  collect() %>%
  mutate(location = factor(location, levels = paste0("Skog_", 1:10)))
```

```
tree_agg %>%
  ggplot(.) +
  geom_bar(aes(x = location, y = avg_age, fill = no_spec), stat = "identity") +
  scale_fill_nina(name = "Antall treslag",
                  discrete = T,
                  palette = "darkblue-orange") +
  ylab("Middelalder på de 2 største treene") +
  xlab("Lokalitet") +
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1))
```


200
150
100
50
0
Middelalder på de 2 største treene
Skog_1
Skog_2
Skog_3
Skog_4
Skog_5
Skog_6
Skog_7
Skog_8
Skog_9
Skog_10
Lokalitet
Antall treslag
1
2
3